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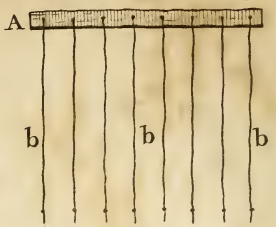
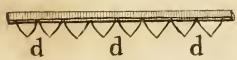
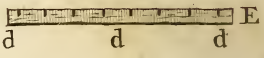
Plate I.

Fig. VII.







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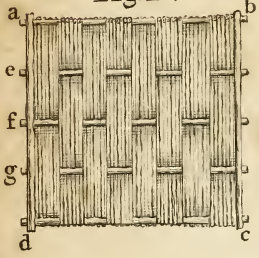


Fig. IV.

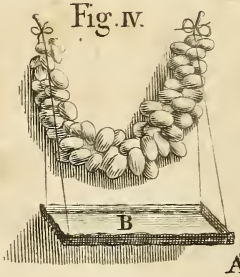
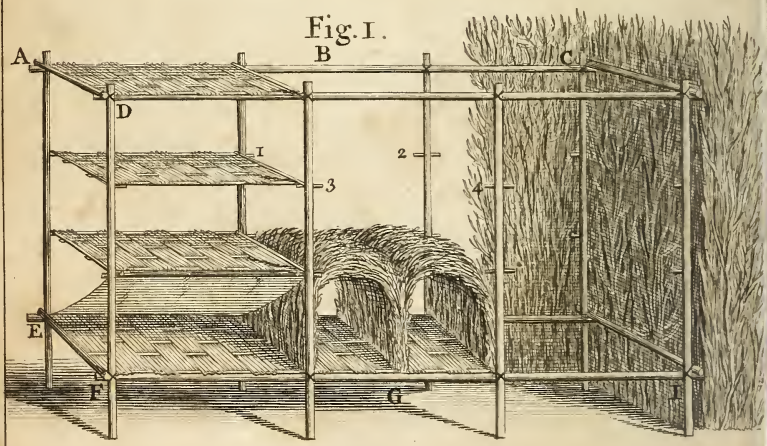


Fig. V.

Fig. I.



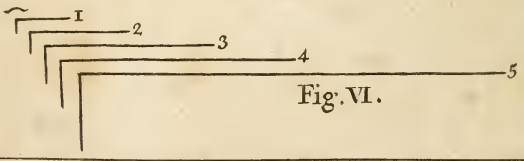


Fig. VI.

Fig. II.

THE

CULTURE of SILK:

OR, AN

ESSAY

ON ITS RATIONAL

PRACTICE and IMPROVEMENT.

IN FOUR PARTS.

I. On the raising and planting of MULBERRY TREES.
II. On hatching and rearing the SILK-WORMS.
III. On obtaining their SILK and BREED.
IV. On reeling their SILK-PODS.

For the Use of the AMERICAN Colonies.

BY

The Rev. SAMUEL PULLEIN, M.A.

And hasten to the Work each beauteous Maid,
Draw hence expressive Dress to Beauty's Aid,
Your Labour to the pleasing Task is due,
The willing Insect toils and spins for you.
PULLEIN's Translat. of Vida's Silk-worm.

LONDON:
Printed for A. MILLAR, in the Strand.
MDCCLVIII.

of a great Prince; and Britain's Commerce has its glory in the care of her Princes.

That your Royal Highneſs may, in Peace and Proſperity, ſee this and every other branch of it advance to perfection, is the ſincere wiſh of

YOUR ROYAL HIGHNESS'S

Moſt dutiful,

And obedient Servant,

SAMUEL PULLEIN.

PREFACE.

THE buſineſs deſcribed in this book requires no fund to begin it: it may be perform'd by the poor and weak, the young and aged, women and children. This, and the culture of ſilk in ſome of our *American* colonies now becoming an object of publick concern, were the principal motives of my engaging in this ſubject.

To write upon any thing which is the immediate object of practice, is by no means ſo uſeleſs as the bulk of practitioners imagine. Agriculture and all the parts of Huſbandry have long been Arts of common practice, and yet will be ſubjects proper to be treated, ſo long as they are Arts capable of improvement; and, even tho' they were capable of no further improvement, yet it is neceſſary to make publick what is already known, that perſons who have not the opportunity of living inſtructors may be encouraged to begin their journey by having ſome directions of their road. In *France*, tho' the culture of ſilk has long

been a practical art, yet books are ſtill written upon that ſubject, which has without doubt this good conſequence, that it engages many in that buſineſs who would otherways never have thought of it, becauſe they had no rule to ſet out by.

The few things which have been publiſhed, in *Engliſh*, on the culture of ſilk, have not explained even the preſent practice in ſuch a manner, as to extricate perſons from the difficulties they would meet in their firſt tryals; much leſs have they attempted to lay any foundation for future improvements: they were too conciſe to take in the various incidents that might diſturb a young practitioner, and, in many difficult parts, ſo obſcure that they ſeem to be only verbal tranſlations, without any knowledge of the ſubject. As an inſtance of this, let any one read the deſcription given of the reel in a quarto, dedicated, I think, to the Lords Commiſſioners of Trade, in which there is either a total neglect, or a total ignorance of its moſt eſſential movements. I need not mention the many material circumſtances which are omitted in the hatching, feeding, and obtaining the breed of Silkworms.

In

In the following treatiſe I have attempted to bring together the beſt and moſt material things which have been delivered by different authors. And, having myſelf many times gone through the practice of the four different parts into which I have divided the ſubject, I have thence taken occaſion to mention ſuch improvements as I had actually tryed, and alſo to ſuggeſt ſuch as I had reaſon to think would, on tryal, be found uſeful: by theſe means attempting to impart what I already knew, and directing to ſuch tryals as might diſcover more than I knew, and ſtriving to enter ſo far into the reaſon of things, as might give ſome light to future diſcoveries.

If ſome ſhould think I have treated the ſubject too minutely; I can only ſay, that this was owing to my obſerving that brevity in rules which were to be put in practice was often the cauſe of obſcurity and error.

If inaccuracy of expreſſion ſhould occur, I can only offer in excuſe the multitude and variety of precepts, where the mind, while exerciſed on the matter, muſt be often inattentive to the form.

If the number of rules ſhould be thought too great to be ſuddenly comprehended, I ſhall not deny it, but at the ſame time I flatter myſelf that many of them will, from time to time, be conſulted as difficulties occur, and often ſhew, or at leaſt ſuggeſt ſome remedy.

In ſhort it may happen that this treatiſe may be ſuddenly cenſured, and ſlowly found uſeful; or may without either praiſe or cenſure ſleep in obſcurity. But, while I am convinced of the intention with which it was wrote, and of opinion that it can at leaſt do no injury to the cauſe which produced it, I ſhall not add ſolicitude about its credit, to the trouble which it has already coſt me; I do not ſhew it to the publick with the over-valuing fondneſs of a parent for a child of his own begetting, but only offer it as a foundling whoſe aſpect gave ſome hopes of its proving uſeful to its country: I have wrapped it up in ſuch homely dreſs as came readieſt to my hand, and in this deliver it to be educated according to its talents.

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PREFACE.

THE
Culture of SILK.

PART I.

CHAP. I.

Some introductory obſervations on the breeding of Silkworms, with regard to different climates.

NEITHER Animals nor Plants, when tranſported from one climate to another of a different temperature, are immediately naturalized; there is ſome time required, and often ſome ſucceſſions of generation, before their nerves and fibres can adapt themſelves to the different influence of the air and ſun; and if the ſeaſons were ſteady and regular in their native country, but mutable and irregular in that to which

they were brought, ſome time muſt be neceſſary before their fibres can acquire a facility of contracting and extending with ſufficient quickneſs to anſwer the ſudden changes of the weather. Thus we may obſerve, that the natives of *England* and *Ireland* are not ſo affected by the variability of our ſeaſons, as thoſe born under the ſteady climates of *Italy* and *France*: hence alſo we can account why old perſons, whoſe fibres, by growing rigid, have loſt the power of adapting themſelves to the ſudden changes of the weather, are very ſenſibly affected by its variations.

The conſequence which I would draw from the foregoing obſervations is, that it cannot be expected by us, that ſilkworms bred from eggs, imported recently from *Italy* or *France*, can immediately thrive. Thoſe therefore who attempt the breeding of ſilkworms here in *England*, had better raiſe their ſtock from eggs which have, for ſome preceding generations, had their original among us.

With regard to our colonies on the continent of *America*, ſilkworms might be rear'd in them all to perfection, from *New-England* to *Georgia* incluſive; for the mulberry-tree will

will grow in moſt of them without any culture, and the ſummers in the moſt northerly provinces are ſufficiently warm; but many of them are ſo engaged in the planting of tobacco, that no hands can be ſpared, the management of that, and of ſilkworms, being at the ſame time of the year, and thoſe who are employed about tobacco are very unfit to attend ſilkworms; and yet I believe it would ſcarce be a loſs to *England*, if the former was ſomewhat neglected for the ſake of the latter. The great quantities of ſilk which might be imported thence into *England*, the number of hands which it would employ, the various manners in which it might be mixed with the manufacture of wool, and the revenue that might in time ariſe upon its importation, ſeem to be things well worth the encouragement of the *Engliſh*; and in *America* the comfortable ſubſiſtence and enrichment of many ſmall families, by raiſing ſilk, would be of much more benefit to our colonies, than that the labour and induſtry of the poor ſhould be laid out only for the advantage of ſome rich planters.

In ſome of the colonies a double produce of ſilk might be obtain'd in one ſeaſon, and the warmth of the climate would make the ſlighteſt accommodation of houſes or even ſheds ſufficient, and many of the cautions and obſervations delivered in this treatiſe unneceſſary; ſo that, there, what regards the keeping of the ſilkworms warm, need not be ſo much attended to as what gives them air, and keeps them clean. I ſuſpect however, that the moiſture, which is occaſioned in ſeveral parts of our *American* colonies by their being not yet clear'd of their woods, may be of diſſervice to the rearing of ſilkworms; at leaſt, I believe, this may make it a matter of ſome importance, to chooſe thoſe places where the woods are well clear'd away, and to avoid thoſe which are ſituated near ſwamps and great lakes, or expoſed to the north and north-weſt winds, which, in our part of *America*, are the moſt cold and piercing.

Some attempts having been made to rear ſilkworms in *England*, it may not be improper here to ſay ſomething concerning them. And firſt, I muſt obſerve, that the changes which frequently happen in our weather is the greateſt obſtacle; for though the time

time in which ſilkworms are fed and ſpin be no more than about ſix weeks, yet there frequently happens, in that time, ſo many days of hazy and moiſt weather, or ſuch ſharp winds, as greatly retards their coming to perfection, and often kills one half of the brood.

This inconvenience of the climate may in ſome meaſure be remedy'd by perſons of ſubſtance, who can chooſe a convenient and warm part of their houſes, and occaſionally light a fire to conquer the inclemency of the air; and who beſides have time and leiſure to overſee and direct the management of the ſilkworms. But theſe being things which are out of the power of the lower claſs of people, I ſhall take it for granted, that the culture of ſilkworms cannot be performed by them, and ſhall therefore only addreſs what I ſay here to ſuch as have leiſure and abilities, and may, in the culture of ſilkworms, find a pleaſing ſummer amuſement, and not altogether unprofitable.

I have mentioned, that cold and raw weather may be palliated by the ſituation of the room, which ſhould have windows to the ſouth, and alſo by occaſionally

making a fire, which laſt ſhould eſpecially be regarded during the two or three days in which the worms are employed about ſpinning their ſilk-pods; for if the weather is then cold or raw, they will make little or no ſilk, and ſo you will loſe all the advantage which was expected from them. The ſame caution ſhould alſo be obſerved when the moths are coupling and laying their eggs, otherwiſe they will lay but few.

Since mulberry-trees, eſpecially the black ſort, can be eaſily rais'd, I ſhall ſay nothing as to the objection of want of food; but ſhall only caution any perſons from attempting to breed ſilkworms, who have not plenty of leaves at their own command, ſince I know with what difficulty they are procured from others.

Another objection is, that the worms are often hatch'd by the heat of the weather, before the leaves are come out to feed them; but if you keep the eggs in a ſmall viol bottle, covered with a piece of paper prick'd with two or three pin-holes, and placed in a cool ſituation, where neither the heat of the ſun nor the air of a fire can affect it, yet free from moiſture

or

or cold winds, this will hinder them from hatching during the latter part of April and beginning of May; and if you are not then prepared with food, place the bottle in a veſſel of cold water ſo deep as the eggs lie in it, or a little deeper, and this will further retard their hatching.

It may be ſaid, that the conſtant attendance of feeding the worms three or four times a day would occaſion too great a confinement, but this is a work which any ſervant, who has once ſeen it, may eaſily perform; and therefore, I think that a lady might, even in theſe climates, make herſelf a ſuit of ſilk with the tenth part of the trouble, and by a more agreeable amuſement than that ſedentary one, which compleats a wrought head-dreſs. Moſt indeed that go about breeding ſilkworms, do, for want of method, or by following fanciful ones, make it a troubleſome buſineſs, and oft-times the very pains which they take creates more labour. They let the eggs be laid on paper, they are hatch'd at very diſtant times, they are ſometimes pick'd up ſingly as they hatch, and placed on ten times more leaves than are neceſſary, which occaſions frequent clearing away of

their litter; when they are fed, numbers often periſh under an overbundance of leaves; young and old are mix'd together, and by that means the proper management during their periodical ſickneſs becomes impracticable; at laſt, when thoſe worms which ſurvive this management, are ready to ſpin, they are watch'd, and pick'd up one by one, and placed ſeverally in little paper cells, which are afterwards pinn'd one by one to the ſides of the room.

This is the method generally followed by thoſe who keep ſilkworms among us; and as every part of it is wrong, every ſtep toilſome, it is no wonder that thoſe who proceed in this manner, ſoon grow tired of the work; they reckon over all their worms, and when they have rear'd one or two thouſand, they account it a prodigious number; they perhaps afterward reel off ſome of the balls in a method both tedious and toilſom; and, having at laſt produced an ounce or two of ſilk, they are amazed at the great number of worms, and the great labour which is neceſſary to produce a ſmall quantity of ſilk. But this is much the ſame, as if a farmer ſhould run into every wrong method of huſbandry, and at laſt

laſt complain of the fatigue, and of the many millions of grains that went to make a few barrels of corn. But when it can be ſhew'd, that two or three large mulberry-trees, or a proportional number of ſmall ones, will feed a ſufficient number of worms to make above a pound of ſilk; that the ſtand which holds theſe worms will not take up a yard's ſpace in a room; that one perſon ſkill'd in reeling can, with the help of a boy to turn the reel, wind off two or three pound of ſilk in a day; that one pound of this ſilk will make near five yards of paduaſoy; that the whole time, from the hatching of the eggs to the reeling of the ſilk, amounts to no more than ſix weeks; and that a ſmall part of each day is ſufficient for the proper attendance; that beſides all this, it can be done with much leſs trouble than is generally undergone; theſe things, I ſay, being conſidered, and, as I hope, ſhewn in the progreſs of the inſtructions given in this book, then the management of ſilkworms will appear perhaps in a more inviting light, and be look'd upon as an entertainment neither unpleaſing nor unprofitable.

An opinion indeed has gained ground, that the rearing of ſilkworms is an unhealthy employment; but this I am ſure has no foundation, unleſs where they are kept in a ſlovenly manner, and their litter or the dead worms ſuffered to corrupt and taint the air; for while the litter continues dry, and the worms healthy, I never found the ſmell to differ much from that of hay, though by a perſon's being prejudiced, that ſmell, as coming from worms, may be imagined very diſagreeable. Indeed the ſedentary employment of poking over the worms, and picking them from the leaves, is not a very healthy amuſement for the perſon who uſes it, and I am ſure it is hurtful to the worms.

If the method follow'd here by ladies were purſued in the ſilk-countries, ſilk could ſcarce be ſold for leſs than its weight of gold; but if rules and method are properly followed, the pains which they beſtow upon ten worms would ſerve for ten thouſand. An improper method of hatching the eggs diſturbs the whole proceſs of rearing the worms for ever after; and improper ſteps in the management of them diſturbs all the ſubſequent ones; and therefore

fore to lay aſide their preſent practice, and ſet out upon a new method, is the only thing that can make the feeding of ſilk-worms in *England* an eaſy amuſement. The intention of this treatiſe is not only to preſcribe the preſent practice in the ſilk-countries, but to point out ſome things, and give ſome hints, for its improvement, eſpecially at a time when there is a fair proſpect of introducing the culture of ſilk into our *American* colonies.

CHAP. II.

Of the different kinds of Mulberry-trees.

THE mulberry-tree is the foundation of the ſilk manufacture, its leaves being the food ſo peculiarly adapted to the worm which affords us their rich materials, that no other can be ſubſtituted for it with any advantage.

There are two ſorts of mulberry-trees, one call'd the black, and the other the white. The black is that which is commonly planted in gardens for the ſake of its

its fruit, which, when ripe, is of a black colour, its leaves are very large and rough, and of a darker green than the white ſort, its ſtem generally inclines to be warped and crooked, and its bark rough.

The white mulberry-tree is ſo called, becauſe its fruit is either of a white, or a pale grey colour; it grows with a ſtraighter ſtem and ſmoother bark, which is alſo of a lighter colour than that of the black mulberry, and its leaves are ſmooth, thin, and much ſmaller. It is rarely met with in gardens, for its fruit is of no value, being very ſmall, and of an inſipid ſweetiſh taſte.

Some of the writers on ſilkworms mention a third ſort of mulberry-tree, which they call the white mulberry-tree, bearing little red berries. This is perhaps only a variation occaſioned by ſoil and climate, for the white ſort ſometimes bears reddiſh berries. There may chance alſo to be different kinds, by the *farina*, or male-duſt, of one ſort impregnating the ſeed of another, when the trees of different ſpecies grow near one another. Perhaps mulberries, ſtrictly ſpeaking, may be all of one ſpecies, and the varieties which appear among

among them only accidental; this might be aſcertained, by impregnating the ſeed of one ſort with the *farina* of another: for if the mules produced from this mixture bore fruit whoſe ſeed was prolific, and would grow when ſown, then we might conclude them of the ſame ſpecies; and this is perhaps the ſureſt method for diſtinguiſhing the kinds in all plants and animals, ſince it is well known, that mules, both vegetable and animal, are barren; Providence ſeeming to have fixed this quality as an obſtacle to the infinite confuſion of ſpecies, which would otherwiſe have follow'd from infinite mixtures; but this I only mention occaſionally: In treating of ſilkworms, it is ſufficient to preſerve the diſtinction of mulberries into the black and white ſorts.

Beſide the uſe of the mulberry-tree in the production of ſilk, its timber is ſaid to be very ſerviceable, and it has the property of bearing wet, without rotting, better than any other; yet there is no tree whoſe bark ſo readily parts from the wood, if the wet gets between them while in a growing ſtate. The inner rind of this tree is tough, like hemp, and might be twiſted

twiſted into a ſtrong cordage : moſt cattle are very fond of its leaves, which are very fattening; for which purpoſe they are alſo given to poultry, being bruiſed with a mixture of oatmeal. The black ſort is a very delicate and wholeſome fruit, and uſeful in many diſorders of the throat and mouth; the tree itſelf makes a very fine appearance in ſummer, ſcarce any other having a more beautiful ſhew of foliage.

The root of the mulberry tree ſhoots very deep into the ſoil, and is no hinderance to almoſt any thing which is planted about it, ſince the ſurface of the earth is not impoveriſhed by it, as it often is by other trees whoſe roots do not go deep; neither is its ſhade, nor the dropping of rain from its leaves, reckon'd injurious to plants.

Since the root of the mulberry ſtrikes ſo deep, in order to bear good fruit, the black ſort ought to have a deep rich ſoil which ſhou'd be digged and manur'd annually like that of other fruit-trees ; it is therefore a very bad method, which is generally followed, to leave a graſs plat under it which prevents the ground from ever being opened and manured : this graſs-plat is left for the ſake of ſaving the fruit which

which are apt to fall with a very little wind, and are very eaſily bruiſed, but a coarſe cloth or winnow-ſheet wou'd ſerve as well, and not hinder the culture of the tree.

When mulberry-trees are only kept for the uſe of ſilkworms, the ſoil and culture are not of ſuch conſequence; and the leſs they run into fruit it will be the better; however, you ſhou'd always have ſome planted in a good ſoil and ſituation, and properly manured, to haſten their coming into leaf, that ſo you may have food for your ſilkworms early in ſpring, and not be obliged to keep their eggs from hatching till it is ſo late, that in hot climates, the midſummer heat wou'd come before they went to ſpin, or that, in temperate climates, the cold might advance before they laid their eggs, either of which wou'd be very hurtful.

Both the black, and the white mulberry leaves will feed ſilkworms, but the white ſort is preferred, and generally uſed, at leaſt in Europe; for which the following reaſons are alleged. Firſt, that their leaves are more tender and delicate, and more eagerly deſired by the worms. Secondly, that they

they come into leaf a fortnight, or more, ſooner than the black, by which means your ſilkworms can be fed earlier in ſpring, and you avoid the inconvenience of hatching them late as mentioned above. Thirdly, the white is a quicker grower, and will not be ſo much hurt by pulling its leaves, nor be ſo incommoded with fruit as the black. Laſtly, the ſilk produced from its leaves is ſaid to be finer.

The early budding of the white mulberry is very advantageous, becauſe the ſilkworm is often apt to be hatched before there is food for it. The tenderneſs of its leaf, and its agreeableneſs to the young ſilkworm, is alſo very uſeful, becauſe the young broods, whoſe teeth are tender, cannot ſo eaſily pierce the thick leaf of the black mulberry; and any one may eaſily obſerve with what difficulty the worms eat any part of a leaf, except the edge, until they have made a hole in it, and ſo formed an edge for their teeth to lay hold on. Indeed after their three firſt ſickneſſes are paſt, they ſcarce have occaſion to make holes, becauſe four or five worms attacking a leaf on its edge ſoon devour it. The inconvenience of much litter and moiſture,

moiſture, which might follow from the fruit of the black mulberry, may alſo attend the uſe of the white mulberry leaves; but ſuch trees as are great fruit-bearers, ſhould not be choſen for feeding ſilkworms. Laſtly, if finer ſilk is made from the white mulberry, it is a material circumſtance. Yet I think it not improper to have ſome of the black mulberry-trees as well as white, ſince it is certain that good ſilk can be produced from them, and that one tree of them is equal to two of the others for quantity of leaves; ſo that, in caſe of deficiency, they would always be a reſource; in the colder climates I know they thrive beſt, and even in *Perſia* they are ſaid to be made uſe of in rearing ſilkworms; however, for our colonies, I would always be ſuppoſed to intend the white mulberry-tree; and though, in the ſubſequent rules for raiſing them, I ſhall make no diſtinction between the black and white, ſince the method of raiſing one ſort may ſerve for the other, yet at the ſame time I muſt obſerve, that, ſince many of theſe rules are adapted to climates where the tree requires ſome care and nicety to raiſe it, therefore the very ſame care and caution will not

be neceſſary in warmer climates, and ſuch countries as ſome of our colonies, where it may be accounted a native of the ſoil; a perſon's own judgment will here direct him in the variation he ought to make in raiſing plantations.

Since therefore the mulberry-tree is the ſole ſubſiſtence of the ſilkworms, it is a vain thing to attempt breeding them, without having plenty of trees; and the nearer and more convenient theſe trees are for gathering the leaves, ſo much the fewer hands will they require, and the leaves not being carried far, will be ſo much the better; and beſide, upon any unforeſeen deficiency of food, or any appearance of rainy weather, you will be able readily to ſupply yourſelf; and theſe are circumſtances of no ſmall moment.

I muſt acquaint the reader, that great part of the method which follows for raiſing mulberry-trees, is drawn from ſome of the beſt authors which have wrote on that ſubject for the climate of *France*; to which however I have added whatever I have met with, which ſeem'd uſeful, in other writers, and ſome things which were deduced from my own experience; nor have I omit-

I omitted giving hints of ſuch improvements as, though I have not had time and opportunity to try them all, yet ſeem to me reaſonable, and will perhaps upon experiment be found uſeful.

CHAP. III.

The manner of ſaving the ſeed of the mulberry for raiſing plantations.

THERE are three principal methods of raiſing mulberry trees. Firſt by ſowing the ſeed of the berry. Secondly by layers depending upon the mother tree, till they have taken root. Thirdly by branches quite ſeparated from the mother tree, and therefore call'd cuttings. I ſhall begin with the method of raiſing them from ſeed, as it is both the ſureſt and moſt effectual way to produce great numbers; and numbers of ſmall trees will anſwer the end of large ones.

The mulberries whoſe ſeed you intend to ſave ſhould be perfectly ripe, this you may know by their beginning to fall from the trees, by their ſoftneſs, and if you exa-

mine nicely by the kernel being compleatly ripened in the ſmall ſhell which encloſes it; you ſhou'd not chooſe the fruit of thoſe trees which have been ſtripped of their leaves that year, or even the year before, if you can avoid it. Thoſe berries of the white mulberry which incline moſt to a dark colour are reckon'd beſt. It is a good method to ſhake the tree moderately every day, from the time that the berries begin to be ripe, for mulberries do not all ripen together.

Theſe berries ſhou'd be laid thin on the floor of a granary or other airy place, for four or five days, that they may attain their full ripeneſs, and ſhould be removed and ſtirred every day for fear of heating and rotting, eſpecially if they lie thick upon one another, after this they ſhould be poured into a bag of courſe cloath or canvaſs, which ſhou'd be put in water and rubbed very well, to diſſolve and ſeparate the grain from the pulp. If this is not done in a river or running water, you muſt change the water two or three times: then take the pulp and ſeeds which remain mixed in the bag after having preſs'd out the moiſture pretty well, and put it in

in a veſſel of water, where, after ſtirring it a little, the ſeed will ſink, in three or four hours, to the bottom, and the pulp ſwimming uppermoſt may be poured off with the water. The ſeed ſhould then be taken out and dryed upon a cloath in the ſun or in ſome airy place, ſtirring it often. If it is done in the ſun don't let it remain above an hour or ſo for fear of the heat injuing it, but rather take it away as faſt as it dries. After this you may winnow out any duſt which is in it, and keep it in boxes or bags out of the way of mice till the ſeaſon of ſowing.

Sometimes the ſeed will not eaſily ſink to the bottom in the water where you waſh it from the pulp, if it is not very ſound; when you find this to be the caſe, you may ſpread the pulp and ſeed as they are mixed together pretty thin till it is quite dry, taking care that it doth not heat or grow mouldy; and when it is quite dry, which will take a good many days, you may keep it in that form till the time of ſowing, then you muſt pour a little water on it to reduce it again to a ſoft pulp, and when it is about half dry mix an equal quantity of dry ſand or earth, rubbing them

well together; this will ſeparate the grains, and make them fit to be ſown.

Or without mixing any ſand the pulp may be ſown moiſt, by rubbing it on a ſmall hay rope which is to be ſet in a drill of earth with the mulberry ſeed ſticking to it, as will be more fully mentioned hereafter; and for this purpoſe it wou'd have been ſufficient to have only ſqueezed out the juice of the berries without waſhing them in water, as before mentioned.

Thoſe who will not be at the trouble of ſaving their own ſeed, but buy it from the ſeeds-men, ſhould take care that they are not impoſed on; much of what is ſold being often good for nothing, which proceeds either from its being ill ſaved, gathered from unripe berries, or from trees which had been diſleafed; or from its being too old. Seed that is very good and ſound may be known by its ſinking in water after having been ſteeped in it for three or four hours; though, as I mentioned before, when the ſhell is not compleatly filled by the kernel, a good deal will ſwim, and may be ſkimm'd off and ſav'd. It is as ſure a method as any of knowing good ſeed, to crack a few of the ſhells, and obſerve whether

whether they have ſound kernels; this is eaſily obſerved in the black mulberry, which has pretty large ſeeds, but not ſo readily in the white, whoſe ſeeds are very ſmall.

In the more temperate climates it is neceſſary to have good trees, well manured, and in a good aſpect, in order to have ſound ſeed and well ripened; and, in any climate, it would be uſeful to have a few trees of the beſt growth peculiarly ſet apart for ſeed. And if, for want of better, you are obliged to make uſe of the ſeed from trees whoſe leaves have been pulled for the worms, let it be from thoſe trees which were laſt uſed, viz. when the worms were in their laſt age, which have their fruit pretty well grown before they are diſleaf'd, for the berries are hindered to fill when the leaves are pull'd early. If the berries are ripe on any tree whoſe leaves you have occaſion for, it will be convenient to ſhake the tree moderately every time before you pull the leaves; for ſo you will both ſave the fruit for ſeed, and hinder it from mixing with the food of the worms; and on this laſt account you ſhould preſerve for ſeed thoſe trees which are ſo greatly loaded with fruit as to have but few

leaves, ſince it wou'd be almoſt loſt time to pull the leaves, and they wou'd be ſo mix'd with the berries as to occaſion a great deal of litter among the worms; and if they were ſo ripe as to ſhed their juice among the leaves, it wou'd make them unwholſome food.

I muſt add, to what I have already ſaid about ſeparating the ſeed from the pulp, that if, after having been very well rubb'd in a coarſe bag, it is put into a wicker ſieve wrought juſt ſo cloſe as not to let the ſeeds paſs, and kept under a ſpout of water, rubbing and ſhaking it all the time; you will ſoon have all the ſeed clear'd from the pulp. And, by winnowing it when it is dry, you may ſeparate the lighter ſeed from the heavy; the former muſt be ſown thick, as a great part of it will not come up.

CHAP.

CHAP. IV.

The ſoil proper for the raiſing and plantation of Mulberry-trees.

THE ground for raiſing mulberry trees either from ſeed, layers, cuttings, &c. ſhou'd be a rich looſe mould inclining to ſandy, that the tender new formed roots may be the better enabled to extend in it. A ſmall depth of ſoil will be ſufficient for theſe, eſpecially thoſe raiſed from ſeed; but it ought rather to have gravel under it than any ſort of ſtiff clay, which might hold the wet and chill the young plants. In temperate climates the border under a ſouth wall, lay'd ſo as to ſlope a little toward the ſun, will make a very good ſeed bed.

Though a ſmall depth of ſoil is ſufficient for raiſing trees which are to be tranſplanted, yet when they are rais'd where they are to ſtand (as will be ſhewn in the raiſing mulberry hedges) or when they are tranſplanted where they are to remain, a deep ſoil is beſt; becauſe mulberry trees

ſhoot downward with very long tap-roots. It is true indeed, that when they have taken with the ground, they will live, and throw out abundance of leaves, even in a bad ſoil; but then theſe leaves are not ſo good to nouriſh ſilkworms, and eſpecially, when the trees are planted in low watery grounds, they afford but bad leaves, though they may have a greater quantity; for, as they abound too much with moiſture, their leaves approach to the nature of thoſe which grow on the ſuckers of the mulberry tree, and endanger the buſting of the worms which feed on them, eſpecially if they had been uſed to better leaves before.

Chooſe therefore a rich mould inclining to ſandy, looſe, and as deep as you can, where your mulberry trees are to remain. If the ground is not rich enough you muſt help it by digging about the roots, and laying in the mould of old hot beds or other good old manure; and if it is too wet, you may eaſe it of the moiſture by drains. Ground ſloping to the ſouth is the beſt aſpect for a plantation, and it will be the better if defended by a wood or grove, on that ſide from which nipping winds might hurt the young buds in ſpring.

CHAP.

CHAP. VI.

The first method of raising Mulberry-trees from the seed.

FOR raising mulberry-trees from the seed, you should choose some part of an inclosed garden, which has a good exposure to the sun, and is defended from the north wind; the earth should be well stirred, and enriched with some very old dung, and ought naturally to be a good fine mould; then lay out the ground in beds, a little raised above the surface of the earth, of what length you think proper, but not above four feet broad, that they may be conveniently weeded.

The best time for sowing the seed is in *February*, *March*, or *April*; the sooner it is done in spring, when frosts of any continuance are no longer to be fear'd, it will be so much the better, as the plants, by coming up early, will have time to get strength, and be the better able to bear the ensuing winter. As the plants require, according to the difference of climates, six or eight weeks after the seed is sown before they

they begin to appear, I think it is a good rule to ſow the ſeed about ſix or eight weeks before the time in which the mulberry bud begins to open, which may be a ſort of general direction for any climate.

Take therefore the ſeed which you had ſaved, and ſteep it for one night in water, then make it about half dry, and mix an equal quantity of ſand or dry mould with it, the better to ſeparate the grains; ſow this mixture on the beds prepared as above, and ſift over it ſome fine rich mould, ſuch as that of old melon beds, to about a quarter of an inch depth: The beds muſt be watered at leaſt every ſecond day in dry weather, eſpecially toward the time when you expect the ſeed to ſpring up.

While the earth appears moiſt you need not water them, ſince it is very apt to thicken the ſurface of the ground, and make a cruſt gather on it, which hinders the up-ſpring of the young plants; and therefore when you water them, it ſhould be with a watering-pan whoſe roſe has very fine holes; or elſe you ſhould have two or three light hurdles of oſier, ſtraw, or ruſhes, which you ſhould lay upon the ſeveral parts of the beds as you water them, which

which will prevent the mould from being beaten into a cake. If either any froſt happens, or the weather be very hot when you ſow the ſeed, it is proper to cover it with ſome ſtraw for four or five days; this will defend it from either cold or drought according as the ſeaſon is, and alſo from being ſcratch'd up, and pick'd by birds. If the ſeed is ſown on hot-beds, made like thoſe for melons, the plants will advance the better, and not be endangered by cold; but it muſt be watered oft, becauſe ſuch beds ſoon grow dry on their ſurface, from their high ſituation.

Another way of ſowing the ſeed is in ſmall drills made in the beds, about an inch deep, and two or three inches aſunder; by this method you can readily obſerve the weeds, and diſtinguiſh them from the plants, and alſo the ſnails, which are great deſtroyers of the young plants. I would chooſe to make theſe drills run acroſs the bed, and not lengthways, becauſe you will thus eaſier diſcern the weeds and ſnails, and can alſo the readier, with a ſmall hoe or fork, ſtir the earth between each drill, which will check the growth of weeds.

If the ſeed had been preſerved with ſome of the pulp about it, as mentioned in the foregoing chapter, you may ſow it in a drill in the following manner. Firſt ſteep it in water till it becomes a ſoft pulp; then make drills acroſs your beds as before directed, only ſomewhat deeper; then having ſome ſmall ropes made of hay, about as thick as a bulruſh, fix them with two pegs directly over each drill; take now the moiſt pulp and rub it along the rope, ſo as the ſeed may ſtick here and there upon it; having done this, thruſt the pegs down, ſo that the rope may lie in the bottom of the drill, and cover it with earth, after which you may draw out the pegs. This is a very eaſy and good method, and the ſeed will in all likelihood be defended from froſt by the hay rope, and alſo forwarded in ſpringing by the heat of it when it rots.

In climates where the mulberries ripen early in ſummer, they may be ſowed in this manner as faſt as they ripen, without any further trouble than rubbing them, as you did the pulp, upon the hay ropes; by which you will gain almoſt a year in the growth of the trees; but as this is done

done in ſummer, the beds ſhould be duly watered, and the plants, when winter comes on, not being ſo large and hardy as thoſe ſown in ſpring, ſhould be defended againſt froſt with ſtraw or ſome other covering, which ſhould not lie too cloſe for fear of ſuffocating them, and in mild weather ſhould be taken of.

The mulberries may alſo be ſown as they ripen, by firſt ſqueezing out their juice, and then mixing the pulp with ſo much ſand as may ſerve to ſeparate the grains; after which ſow it upon a bed, and ſift mould over it, as directed in the firſt method of this chapter.

If the ſeed which is ſown in ſummer were made to paſs in digeſtion through the ſtomach of animals, it would greatly haſten its ſpringing; by which means, though ſown late, it would not be much inferior in growth to the crop ſown in ſpring. This is true alſo in all ſeeds which are covered with ſhells or ſtones, many of which ſtay often two ſeaſons in ground before they ſpring: poultry muſt not be uſed, for their ſtomach grinds the ſeed; but dogs and other animals might be made to eat great quantities of the berries

ries as faſt as they ripen in hot climates, by mixing them with a little flour or meal, or kneading them with it into a paſte; and from the dung which they make, mix'd immediately with ſand or dry mould to make it fit for ſowing, the plants would ſpeedily ſpring up.

There is nothing ſo deſtructive to the mulberry plants, upon their firſt coming up, and for ſome time after while they are low, as ſnails and ſluggs; they will eat numbers of them down to the ground in one night, and if it is a moiſt ſeaſon, they will almoſt ruin a whole nurſery: You ſhould therefore be diligent to deſtroy them, eſpecially a little after ſun-ſet, which is better than in the morning, for then they have done their night's miſchief. You may likewiſe guard the beds, by ſurrounding them with dry ſoot or aſhes, ſprinkling freſh on it when it is grown wet by rain, but no ſoot ſhould be thrown on the beds, being too hot and ſcalding for the young plants; the ſlugs will not care to paſs over this fence, eſpecially while it remains dry.

Sand ſtrowed on the beds is alſo a good defence, and I have found a handful or two

two of wormwood, put into the pan with which you water them in the evening, to be a good preſervative for that night; but the beſt fence to hinder them from coming on the bed is a rope of hair, which ſhould be trimmed with a pair of ſciſſars, to make it as briſtly as you can; this being pinned cloſe to the ground round the border of the bed, will ſo prick their tender ſkin, that they will not venture to go acroſs it. Therefore, if the place is much infeſted by ſlugs or ſnails, you may uſe all, or as many as you think ſufficient of theſe methods; but if you are neglectful in this point, you may loſe almoſt all the plants of your ſeed-bed. The ſeed-beds of your mulberries muſt be kept very clear of weeds, which would otherwiſe eaſily rob the young plants of their nouriſhment, and ſtunt their growth; nor muſt you forget to water them at leaſt every ſecond evening in dry weather; and if the ſun ſhould be violently hot, ſo as to endanger the ſcorching and making them wither, you may ſhade them from its noon heat, by ſome ſtraw or ſuch like thrown lightly on the beds, and removed when the violent heat of the day is over; but this in

the cooler climates will ſcarce ever be neceſſary.

If violent rains ſhould have waſhed away the earth, and made the young ſeedlings too bare toward their roots, a little fine rich mould put between each drill will repair the injury, and alſo help their growth.

In ſuch climates as *England* the young ſeedlings will not be above three inches high the firſt year. In warmer ones they make a great advance, for in ſome parts of the *Eaſt-Indies* it is ſaid that they ſow large quantities of mulberry-ſeed, whoſe crops they reap down, and feed their ſilkworms with them; and that the ſilk made from theſe tender ſhoots is eaſily diſcernable, by its fineneſs, from that which is raiſed from the leaves, which again ſhoot the ſame year, and are uſed for a ſecond brood of worms. If this is ſo, it is likelieſt to be done by thoſe who live between the tropicks, where, having a double ſpring, the crop which was ſown the ſpring foregoing, may ſerve to feed the worms that are hatched in the beginning of the ſpring following, but of this we have no perfect accounts, as neither of their methods of managing the ſilkworms, in which

they are ſaid to be much more expert than the *Europeans*; and this is not unlikely, they having been in poſſeſſion of the art perhaps almoſt as early as the flood.

If large crops of mulberry-trees were raiſed by ſowing the berries immediately when they became ripe, (I mean in our *American* colonies, for it muſt be where they are of quick growth) ſuch crops might, on the enſuing ſpring, make a good and early proviſion for the worms while they were in their firſt age, and required but a ſmall quantity of food; the whole young crop might ſucceſſively be reaped for the uſe of the worms, and the ſmall ſtems and roots might have ſufficient ſtrength to throw out young ſhoots, which perhaps might be again reaped for a ſecond brood of ſilkworms. I mention theſe methods rather as hints and mementos of trials which may be made, than as poſitive precepts, one intention of this treatiſe being all along, to urge perſons to ſuch experiments as may breed ſilkworms to more advantage than by the common practice.

I ſhall here by the way mention a method of haſtening the growth of ſeed ſown early in ſpring, in ſuch climates where the wea-

ther is not then ſufficiently warm, *viz.* After ſowing the ſeed, ſift over the ſeed-bed the ſweepings or duſt of pit-coal, turf-mould, or any ſuch materials as are of a black colour, which, by imbibing the ſun's rays, will greatly encreaſe the heat of the bed, and promote vegetation. This may be renewed as oft as the rain waſhes the materials into the ground, till the plants appear, and then ſhould be diſcontinued, that the plants may have the advantage of the reflected heat; if a border, which lies under a ſouth wall, be thus managed, a perſon would ſcarce imagine what a degree of heat the border will conceive. Note alſo, that it will much further the ſpringing of all ſtone ſeeds, of which ſort is the mulberry, if they are put into an earthen veſſel with an hole in its bottom, and ſo buried abroad in the earth during the whole winter, and till you deſign to ſow them in ſpring; they ſhould be moiſten'd beforehand, and a ſlate fitted to the inſide of the veſſel's mouth, (but ſo as not to prevent the rain from keeping them moiſt) to hinder mice from getting at them, who, if once they found them out, would in a few days totally deſtroy them, therefore you ſhould

ſhould now and then look whether they had got at them.

CHAP. VII.

The ſecond method of raiſing Mulberry-trees, from cuttings.

THE next moſt eaſy and quick method of raiſing mulberry-trees is from cuttings; and in this method though you cannot ſo readily raiſe the ſame numbers as from ſeed, yet you have an advantage in the quickneſs and ſtrength of their growth. The mulberry is eaſier propagated from cuttings in moiſt and temperate climates, than in thoſe which are extreme hot and dry; for the branches which are ſeparated from the mother tree, having no roots to ſubſiſt themſelves, require to be plentifully ſupplied with moiſture, in order to keep them alive till the roots are formed, and where the climate denies this, the defect muſt be made up with watering.

The cuttings which are to be propagated ſhould not be ſmall ſingle twigs, but pretty large branches, of at leaſt three inches round in the thickeſt part, with all the ſmaller

branches on them; pretty large arms taken from an old ſuperannuated tree will ſerve very well for this purpoſe, and the old tree will have an advantage from this pruning, by putting forth young wood, which will bear larger and better leaves; theſe arms may be divided and cut into leſſer ones, of about a yard or more in length, in order to be layed down in the earth.

As I ſhall hereafter ſhew the advantage of planting thoſe trees which are deſigned for ſilkworms in a ſort of eſpalier hedge, ſo I ſhall now direct the laying down of the cuttings in ſuch a method as that, without any future tranſplanting, many ſuch hedges may be raiſed, and alſo good numbers of plants to be afterwards tranſplanted into hedges; and I am certain from experience, that if cuttings thus managed fail to grow, at leaſt in a temperate climate, it is owing either to want of watering, weeding, or a good ſoil.

The beſt time for planting cuttings is as ſoon as the leaves have fallen in autumn, that the parts which lie under ground may be prepared to put forth roots the ſpring following; for, if they are planted in ſpring they will moſtly fail, for want of roots to

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ſupply the large quantity of nouriſhment which the leaves will ſoon require. The earth where the cuttings are to be ſet, ſhould have been dug, broken, and cleanſed of weeds ſome weeks before, and, if there was a neceſſity, enriched with ſome good loam, very old dung, ſand, or other manure, ſo as to make a fine looſe mould, proper for the young fibres of the roots to ſhoot into; in this make furrows of about one foot in depth and two in breadth, ſloping from the edge to the bottom of the furrow, and of the length which you deſign your hedges; the diſtance between each furrow need not be above four feet, if you deſign future plantations, by taking away and tranſplanting one or more of the intermediate hedges; but if no more hedges are planted than you intend to ſtand in the ſame places, then the trenches ſhould be four or five yards diſtant. The ground that lies between the trenches need not be loſt, but may be made uſe of for any low vegetables, that will not overſhade the young mulberry plants. The trenches ſhould run from north to ſouth, for reaſons given in the chapter on the form of a mulberry plantation.

When you would plant the cuttings, firſt fill the trenches about one third with ſome of the fine mould which was taken out of them, then begin to lay in the cuttings, by placing their main ſtem as flat as you can in the bottom of the trench, and turning up the ſmall branches on each ſide, ſo that their ends may ſtand above ground from three inches to a foot, as they can be conveniently bended and turned up; for which purpoſe, place that ſide of the main branch undermoſt which has feweſt twigs growing out of it, you may bend the ſmall branches, and make them comply as much as you pleaſe, they will not grow the worſe, and where they are ſtubborn you may pin them down with hook'd pegs.

When the large ſtem of the cutting has but few or no leſſer branches coming from it for a conſiderable way, you need not then bury it above three or four inches under the ground, that it may the eaſier ſhoot forth buds from its unfurniſh'd part. And when ſeveral buſhy clumps of ſmall ſhoots ſpring from the ends of the leſſer branches, as is common when the cuttings are taken from old trees, then that part of

the leſſer branch, from which they ſpring together, ſhould always be placed under the earth that they may produce diſtinct roots, for then each of them will, when ſeparated, be a diſtinct tree.

In laying down the cuttings in the trench, place the thick end of each ſubſequent branch to the ſmall end of the foregoing one; and, when they are all properly placed, cover them with mould to the depth above-mentioned, without preſſing or treading it, only make ſome little allowance for the ſinking and ſettling of the mould, and therefore raiſe it with a ſmall ſwelling all along the trench, but ſo as to leave the ſmaller branches above ground as was directed before.

Having thus planted all your rows, you have nothing further to obſerve till ſpring, unleſs it be that, in caſe of a hard froſt, you ſhould cover them with ſtraw, peaſe-haulm, or ſuch like, always taking care that neither goats or other cattle may get at them.

In ſpring, and eſpecially in ſummer, according to the dryneſs of the ſeaſon, they muſt be conſtantly watered, every ſecond day at leaſt, in ſpring about noon,

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and in ſummer about ſunſet, and this for the firſt year can hardly be overdone; and if they were in danger of being hurt by a very hot ſeaſon, they might be defended, during the noon hours, by ſtrips of old matting thrown over them, and they may be uncovered when the violent heat of the day is paſt.

Theſe cuttings thus managed, will on the firſt ſummer put forth ſhoots of about five or ſix inches length, more or leſs, according as they have thriven, and at the ſame time they will fortify themſelves with roots; ſo that if they have made ſhoots, and preſerved their leaves till autumn, you need not doubt of their growth, but if any have fail'd, you ſhould then place others in their room.

On the enſuing ſpring and ſummer, tho' they will then be more out of danger, yet you ſhould continue to water them in very dry weather; and they will this year make ſhoots often half a yard in length, and furniſh themſelves compleatly with roots, ſo as to be fit for tranſplanting in autumn; and then you may raiſe up and cut off from the main ſtem all thoſe buſhy clumps mention'd, with their own roots, in order

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to plant other hedges, leaving only ſuch behind as ſhoot in a line from the principal branch, and in quantity as you ſhall judge ſufficient to form your firſt planted hedge; thoſe that you cut off you may ſeparate and divide into diſtinct plants, according as their roots will anſwer ſuch ſeparation.

As the hedges grow up they may be train'd and kept to a flat form by ſticks woven acroſs the branches, until ſuch time as you begin to pull the leaves for the uſe of ſilkworms; and then, by ſtripping the leaves of thoſe branches which ſhoot right forward, and afterwards clipping them off, you will always preſerve them in this form; you may alſo, by laying down the ſuckers and lower branches, be frequently ſupplied with young trees for new plantations: this method therefore of raſing mulberry trees I take to be as advantageous, and diſpatchful as any that can be purſued; for branches quite ſeparated from the mother tree will, as I ſuppoſe, ſooner furniſh themſelves with roots than layers can do, which, by being attached to and depending on the mother tree, are not under ſuch a neceſſity of putting forth roots to feed themſelves;

ſelves; beſides, that the branches of large trees can rarely be brought ſo low as to be lay'd, but cuttings can at all times be had in plenty.

I would recommend, before the cuttings are put in the ground, as above directed, to dip the part that is cut in tar or melted pitch, or with a hot iron melt it into the cut; becauſe when moiſture inſinuates where a branch is cut, eſpecially in the mulberry tree, it generally makes the bark part from the wood and grow rotten; beſides the pitching over of the cut will as I imagine, hinder it from taking in a large quantity of crude and improper juices, which will now be forced to ſtrain through the bark, and the better prepare it to put on the nature of a root; the ſame method of pitching ſhould alſo be uſed to thoſe cuts which are made in pruning the mulberry tree, that the rain may not injure it.

A late *French* author has made ſome improvements in the raiſing of all trees from cuttings, by which he, with appearance of reaſon, ſhews that they will more certainly take root. He twiſts a piece of braſs wire, round the ſeveral parts of the branch

branch from whence he would have the roots produced. The theory upon which he builds his improvement is, that as the branches of trees are produced generally at acute angles from the ſtem, and tend upward; ſo the roots are produced at acute angles, but in an oppoſite direction downward. The ligature therefore of wire checks the motion of the ſap, and turns it into that direction which is proper to produce roots; and he ſeems to be convinc'd of this theory by experiment. Perhaps ſmall pieces of lead or even tieings of cord, may be found more proper for ligatures than braſs wire, as they will give way to the growth of the branch, and not cut through the bark as the other appears apt to do.

The method here given for raiſing mulberry trees from cuttings, may perhaps be advantageouſly apply'd to the producing nurſeries from many other trees, as well as from the mulberry; all that ſeems neceſſary for producing trees from cuttings, is, that the part which is under ground ſhould, as ſoon as may be, put on the nature of a root, ſo as to feed the branches; wherefore the leſs any particular tree is apt to

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ſtrike root from cuttings, the more of the branch muſt lye under ground to make up the defect, and the more ſhould ſuch other artifices be uſed, as will make it put on a rooty nature; for otherwiſe, though a branch may bud and keep alive during the beginning of ſummer, yet when the leaves are expanded, and perſpiring much, require much ſupply of ſap, as they will do with the advance of the ſeaſon, the branch will often, for want of due nouriſhment, decline apace and at laſt die.

CHAP. VIII.

Of raiſing Mulberry-trees by layers, and other methods.

THOUGH the two methods of raiſing mulberry trees, from ſeeds, and cuttings, are the quickeſt and moſt advantageous, yet, where large plantations are to be ſuddenly raiſed, all other methods may be at the ſame time uſed; layers may be made from low trees, and from ſuckers, which are ſometimes produced plentifully from the roots; but the method of making

ing layers being generally known, need not be particularly inſiſted on; the branches now are bended and pinned down in the earth, leaving only their extremities above ground, and in this ſituation they ſubſiſt on the mother tree, until the parts which are under the earth have formed roots ſufficient to maintain themſelves, and then they are to be ſeparated from the tree and planted out.

Theſe layers are more certain of growth than cuttings, and do not require ſuch watering while they depend on the old tree; but then this dependance makes them lazy in putting put forth roots, with which they often appear but moderately furniſhed, when you come to ſeparate them from the old tree: therefore it would not be amiſs to twiſt wire about the parts laid under ground, as in the caſe of cuttings, and alſo to water them well. The time for making layers is the ſame as that for planting cuttings, and in two years they will be fit to tranſplant. It might however be of uſe, if at the end of the firſt year, you began to wean them from the mother tree, by nicking their branches half through, and putting tar upon the cut; this might

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the better force them to put forth roots for their ſubſiſtence.

Suckers often ſpring from the ground about the roots of trees, which have had their heads torn of by winds, or many of their principal branches lopped of; at leaſt this may be promoted by digging and opening the ground about the roots of ſuch trees: but though ſuch ſuckers ſpring out of the ground, it is uſeful to their well rooting, that they ſhould be bended down, and have earth laid on their lower parts, in the ſame manner as was done with branches layed down.

Beſides the foregoing methods, mulberry trees may be propagated from parts of the root taken up, the more length they have will be the better; theſe may be laid horizontally about two or three inches under ground, in a looſe fine mould, and placed in lines to produce hedges as was done with the cuttings; they may be planted early in ſpring, and will ſoon ſhoot forth plants, which being in their original, ſufficiently rooted, are ſcarce at all liable to failures. The ground however, ſhould be watered in dry weather, both before and after they have ſprung, becauſe the roots

roots lie near the ſurface, being ſo plac'd in order that they might the eaſier puſh forth plants above ground.

Mulberry trees may be inoculated, the white on the black ſort, and the black on the white; the latter method is directed in order to have a ſtraight free growing ſtem to your fruit trees; but theſe being only niceties of culture, and not ſerving to propagate the tree, I forbear dwelling on them, as alſo on what is delivered by ſome authors, concerning the grafting or inoculating of the mulberry trees of a different ſpecies; the ſucceſs of which I very much doubt, having tried it on ſome and failed in the attempt.

CHAP. IX.

Of the planting out of the young Mulberry-trees.

MULBERRY trees raiſed from ſeed, or from parts of the roots layed in the ground, may be tranſplanted the ſecond autumn after; or you may take up only the moſt thriving plants out of the ſeed beds, in order to thin them, and let the remain-

der ſtand another year. Thoſe which are thus taken up are only to be tranſplanted into nurſeries, where they ſhould remain two years more before they are planted out; and one foot is ſufficient diſtance for the ſeedlings to be planted aſunder at their firſt removal from the ſeed beds.

Thoſe which were rais'd from layers or from cuttings may be planted out, in the hedge form as they are to ſtand, on the ſecond autum after they were rais'd; but as theſe are now but ſmall and may therefore be planted, in the hedge pretty near one another; you may after two years more take away every ſecond or more trees, and plant other hedges with them, and thoſe which remain will ſoon enough ſpread and meet one another. This ſame method you may take with thoſe hedges which were originally planted from cuttings, thinning them, as occaſion requires, and making new hedges from thoſe which you take up.

In raiſing up the mulberry plants take care to break as few of the roots as poſſible, and let as much earth as you can ſtick to them, and afterwards proceed to plant them in furrows, made after the ſame manner

manner as was directed in planting cuttings; this is to be underſtood of thoſe which you plant out in the hedges where they are to ſtand; for young ſeedlings may be ſet down in holes when they are only tranſplanted into nurſeries.

Though ſome authors mention that mulberry trees may be tranſplanted in ſpring, yet the ſureſt ſeaſon for doing it is juſt after the leaves have fallen in autumn; for the dry weather, which often happens in ſpring before the roots have ſettled and begun to draw nouriſhment, will much endanger and often kill the plants; but when planted in autumn this is avoided, and there is then nothing to be fear'd, except a ſmart froſt happens ſoon after planting; but this may be hindred from doing any hurt by laying ſome freſh litter, ſtraw, or ſuch like on the ground over the roots.

CHAP. X.

Of the form of a Mulberry plantation for Silkworms.

IN the foregoing chapters I have adviſed the planting of mulberry trees in a flat form or ſort of eſpalier hedge; for though in *France* and *Italy* they uſe only large ſtandards, yet I conceive this to be a very inconvenient form for gathering the leaves, which cannot be come at without ladders and clambering among the branches, in which method much injury muſt be done by breaking them, and alſo frequent danger of falling incurred by the gatherers; beſides more time ſpent in gathering, and after all, the leaves will not be ſo regularly pulled.

Du Haldes, in his hiſtory of *China*, ſays that they are very careful to prune and keep their mulberry trees in ſuch a form, as ſhall be moſt convenient for gathering the leaves, without injuring the trees, and in the moſt ſpeedy manner; for which reaſon they keep them cut to an hollow form, with no branches in the middle; ſo that a perſon, by going round the tree,

can gather all the out-ſide leaves, and afterward, ſtanding on the inſide, thoſe which are within, only by turning round to the different parts; for the trees are kept low, and there is no neceſſity for climbing upon the different branches; ſo that in this method each tree is a ſort of round hedge.

But flat long hedges planted at proper diſtances, one behind the other, are both eaſier made and kept to their form, and can have their leaves more regularly and ſpeedily pulled; for, beginning at one end of an hedge, you may pull, day after day, all the leaves which are one ſide of it, and then, going to the other ſide of it, you in the ſame manner pull its leaves, after which you go to a freſh hedge; but you never return to pull any ſecond growth of leaves, which may ſpring from an hedge already pull'd, for the leaves would injure the worms, being too young for their age: but in ſix weeks you might perhaps pull them for a ſecond brood.

If your hedges run in length from north to ſouth, which will be their beſt ſituation, as both ſides will then equally enjoy the ſun; in this caſe it is beſt to pull the leaves of the eaſt ſide of each hedge, one hedge

after the other; becauſe, as you are to pull them in the morning, theſe will have enjoy'd the morning ſun in the beginning of the feeding ſeaſon; and after having pulled all the leaves on the eaſt ſide, you may then begin with the weſt ſide; for the ſeaſon having now advanced, there will be ſufficient heat to dry the dews on the weſt ſide, though the ſun has not yet ſhone on it in the morning, when you begin to pull the leaves: beſides, the ſun will have ſome influence in ſhining through the hedge, the leaves being already thinned on the eaſt ſide, not but that you may, if there is a neceſſity, order your time of pulling the leaves after the ſun has ſhone a while on the weſtern ſide.

Theſe hedges may produce branches and leaves almoſt to the ground; by which means they will be eaſier pulled than thoſe of ſtandard trees; and if rain ſhould have much wet the leaves, and you are in immediate want of food for the worms, you can with a forked pole, fixed againſt the larger branches, ſhake and diſlodge great part of the wet: beſides, if rain falls with a little wind either from the eaſt or weſterly points, then one ſide of the hedge will not

not be ſo ſoon wet, and you may then take the advantage of pulling the leaves on the leeward ſide; when you are forc'd to this, for the better regularity keep to one hedge, and mark the place which you pull'd, by thruſting a ſtick into the hedge, that you may not diſleaf the ſame part a ſecond time.

Beſides what has been mentioned, the eaſe with which leaves can be gathered from hedges is of great importance, as the gathering of them makes one of the principal labours in feeding ſilkworms; and I dare affirm it will be found by experience, that one perſon ſhall be able to pull twice the quantity of leaves from hedges which he could do, in the ſame time, from ſtandard trees; for there he can readily ſee what lies in a flat form before him; he will not be delayed in clambering from branch to branch, as he muſt in pulling the leaves of large ſtandards; nor will he injure the trees by breaking the ſhoots, as frequently happens when perſons are obliged to climb for the leaves. And if the hedges are clipped for the worms, which is practicable, eſpecially in the white mulberry whoſe ſhoots are ſlender, it will

make ſtill greater diſpatch. This however, need not be done till the ſhoots have got ſome length of growth, for when the worms are very young, it is eaſy to make proviſion for them.

It is of conſequence alſo to have the plantation at no great diſtance from the place where the ſilkworms are kept, that you may not ſpend much time in bringing the leaves home, and alſo that you may the readier be ſupplied upon ſudden occaſions; or when the weather threatens rain, and warns you to make a proviſion of leaves before they have received wet, becauſe it would be a great labour to dry them for large quantities of worms, and yet this muſt be done if they have receiv'd any moiſture.

Theſe are ſome of the principal advantages which would be obtain'd by mulberry-trees being planted in the form of hedges; the ſame would be obtain'd, if the ſingle trees were train'd in a flat form, though they did not compoſe one continued hedge, in which caſe the branches might be allowed to extend laterally as far as they could, and when they become too long to ſupport themſelves, they might be ſupported here and there by branches of aſh or other

other timber fixed in the ground with the thickeſt end downward, the ſmaller ſhoots of which branches being cut ſhort, would make ſo many hooks for the mulberry branches to reſt upon; and indeed where mulberry hedges grew ſo thick as to hinder the lateral extenſion of their branches, it would be proper, from time to time, to take away every ſecond tree, and tranſplant them ſo as to form a new hedge, ſtill leaving ſo much room between the trees, both in the new and old hedge, that they ſhould not quite join in two or three years, by which method you would not till then be obliged to thin them again.

It would be of uſe to have your mulberry plantation ſheltered by ſome taller trees, on that ſide from which ſharp blaſting winds do proceed in the ſpring of the year; a row or two of trees planted in this manner would often preſerve your mulberry-trees from being nipped in the bud, and would always contribute toward their budding more kindly, and ſomewhat earlier; theſe trees would alſo make the better ſhelter if they were train'd in an hedge form; and where any grove happens to be already planted, the ſheltered ſide of it

may

may be made uſe of for a mulberry plantation, if it is in other reſpects convenient, for ſuch ſhelters ſhould not be too near the mulberry-trees. Fir or other large ever-greens would make the beſt ſhelter againſt any ſharp winds, which might blaſt the buds of the mulberry in winter and ſpring.

CHAP. XI.

Of the culture, pruning, and management of Mulberry-trees both for Silkworms and Fruit.

FEW perſons beſtow much trouble on thoſe mulberry-trees which are deſigned for ſilkworms; and yet it is certain, that the leaves will be more wholſome and the trees thrive the better by culture. In thoſe countries of *Europe* which produce ſilk, the leaf-gatherers do, for the moſt part, clamber on the trees, and, thro' haſte in pulling, break the branches, and otherways very much injure the trees; for this reaſon, and other advantages mentioned in their proper places, I have all along

along recommended hedges, or trees train'd to a flat form. The chief culture which theſe will want is, now and then to dig and ſtir the ground all along over their roots, and if the ſoil is poor, to help it with ſome very old dung mix'd with ſand, lime, marl, good mould, or other ſuch manure as lies moſt convenient, and is beſt ſuited to temper and improve whatever natural defect there is in the ſoil; this at leaſt will be very uſeful for ſuch a part of your hedge as you deſire ſhould bud ſoon in ſpring for the new-hatch'd worms.

Theſe hedges ſhould be pruned by clipping of the ſhoots from which you have ſtripped the leaves as ſoon as you conveniently can, for being done in ſummer, the cut will better heal, new branches will be form'd for the enſuing year, and the hedge will be kept flat and regular; underſtand this when you do not clip but ſtrip the leaves to feed your ſilkworms, for if you clip them they will want no other pruning.

But if your trees are common large ſtandards, they may want pruning either when the branches are grown ſo old as not to bear good leaves, or when they have grown

grown ſo very long as to become top-heavy, and not well furniſhed with leaves throughout their whole length, or when you deſire that ſome of them ſhould produce more delicate and tender leaves.

On theſe occaſions, ſome perſons in the ſilk-countries manage their mulberry-trees as ſallies are ſometimes uſed, by cutting off the whole head, that new ſhoots may ſpring out; but this is a very bad method, for it hurts and damages the tree beyond meaſure, ſo many and large wounds ſcarce ever healing without letting the moiſture in, and ſo rotting the trunk, that the tree never after becomes ſound, and beſide ſome years are loſt before it can again compleatly furniſh itſelf with branches; whereas, if you prune the tree in ſuch a manner as to leave a good length of all the larger branches, theſe will ſoon furniſh themſelves with young wood, and the tree will not be in ſuch danger of being rotted by the moiſture, or killed by too large amputation.

The branches ſhould be cut ſloping, that the rain may not ſettle on the cut. By this kind of pruning, you will ſtill leave ſomewhat of the form of a tree, only with

with its branches conſiderably ſhortened, and a few ſeaſons will make it as handſome as it was at firſt, and will not leave it a large unhealthy trunk, with a thick buſhy head, as the other method would do; and this pruning may be performed, as I hinted before, in any of the ſummer months, immediately after you have uſed the leaves for the ſilkworms, by which means you will have reap'd the advantage of your trees before you leſſen their branches, and in ſummer pruning, the bark ſooner covers the cut.

It may be convenient in the foregoing method of heading trees, to leave a few of the ſmaller branches and twigs upon the larger arms, and the leaves of theſe ſmaller branches ſhould have been ſpared and not pull'd of, that they may ſerve to draw nouriſhment, and keep the tree alive until it has furniſh'd itſelf with young wood; the cut alſo made in pruning would be the better, if made cloſe to ſome ſmaller branch, that the bark might the ſooner cover it, and a little ſmearing with tar would be of advantage.

Trees which are thus largely diſbranched, ſhould not have their leaves pull'd for the

ſilkworms

ſilkworms till the ſecond time of their budding after it, both becauſe the leaves would be too tender and unwholſome for the worms, and alſo the life of the tree endangered by it.

The black mulberry-trees, which are kept for the ſake of their fruit, will require the foregoing culture, when they become ſo ſuperannuated that the berries grow ſmall, and ripen ill, as is the caſe of many trees in cool climates, where people complain of the mulberries not coming to perfection, yet uſe no culture to perfect them; and beſides this, even young trees ſhould have the ground about their roots dug, opened, and enriched with manure, in order to make them bear well, and to make young plants bear the ſooner, they ſhould have been grafted or inoculated from a good kind.

The ripe black mulberries would, I believe, make a moſt rich and delicate wine, could they be gathered in ſufficient quantities at once, but they ſeldom ripen together, therefore it would be neceſſary to have a great many trees, in order to have quantities worth preſſing, for when full ripe, they will ſcarce keep above one day without

without beginning to grow mouldy; perhaps it may be found that they will ripen more equally in eſpalier hedges, and alſo that the fruit can be gathered with leſs trouble than on ſtandards. In *London*, where they have mulberries in great perfection, they uſe ladders, pretty wide at bottom, but tapering ſo as that the two legs become join'd in one for about a yard in length at the top, this makes it eaſy to be fix'd between the forks of the branches againſt any part of the tree, without danger of overturning; they gather the fruit in long chip baſkets, tapering to the bottom, which keeps off the weight of the upper fruit from preſſing that which is below, the mulberry being of all fruits the eaſieſt to be bruiſed; the baſket is hung by a hook'd ſtick acroſs one of the branches of the tree near the gatherer, which allows him to have both hands at liberty, and he moves it as he ſees convenient from one branch to another.

This method doth very well for gathering ſmall quantities of mulberries, but would be too tedious for making wine, ſince mulberries don't grow in cluſters, but ſingle, and muſt be gathered one by one;

one; therefore it ſhould be try'd whether they cannot be ſhaken on a coarſe woollen cloath, not by climbing on the tree, but by placing a forked pole againſt the branch, and ſhaking it gently, ſo that only thoſe which are ripe may fall; and in this way perhaps ſufficient quantities might be collected from a good number of trees, and preſs'd every day as they were gathered, ſo as to make good wine.

Mulberries afford a great quantity of very rich juice, it ſtains the hands much, and will not come off with ſoap and water, but any acid, ſuch as vinegar, lemon, or ſorrel immediately diſcharges it; the pulp which remains after preſſing may be preſerved to raiſe ſeedlings.

I muſt not omit mentioning, that the mulberry-tree, by being planted againſt a wall, may be made to ripen its fruit in very cold climates, and that one or two trees are very ſufficient to furniſh table fruit, which, as it doth not ripen all at once, will often continue to afford a freſh ſupply every day, during the ſpace of ſix weeks.

Many of the obſervations made here concerning the mulberry, may be apply'd

to

to the raiſing and culture of ſeveral other trees; and though in many places there are things mentioned only as probable conjectures, it is hoped they will afford ſome foundation for uſeful trials, which however ſhould always proceed with caution, and not be made in ſuch a large manner, as to become extenſively dangerous; it is thus that experiments become uſeful. But if they are made all at once, and in a very extenſive manner, then, though they ſhould be founded in reaſon, they will moſt commonly prove abortive, becauſe ſome minute circumſtance will be omitted, while the attention was engaged wholly on what was indeed more material, but not entirely ſufficient for the ſucceſs of the trial; and it is chiefly for want of a prudential conduct, that experimentors have often ſuffered, both in their fortunes and in the opinion of the world.

THE
Culture of SILK.
PART II.

CHAP. I.

A general brief view of the Silkworm's life, with the choice of place proper for rearing them in.

THE ſilkworm proceeds from an egg laid in ſummer; it is yellow when firſt laid, but in three or four days turns of a blueiſh colour; its ſize is about that of a grain of muſtard; it is preſerved till the following ſpring, and is then hatch'd either by the natural warmth of the weather, or by artificial heat.

The worm that proceeds from this egg is about a quarter of an inch long, as thick as a ſmall pin, and of a black colour; three or four days warmth generally hatches it. This worm, from ſo ſmall a ſize, doth,

doth, in the ſpace of about ſix weeks, grow to be above two inches and an half long, and an inch and half round, after which it deſiſts from feeding, and begins to form its ſilk-ball.

It begins the outſide of its work firſt, and keeping ſtill in the inſide, forms an hollow ball of ſilk round itſelf, which it generally finiſhes in three or four days from the time of its beginning to ſpin.

It lies incloſed in this ball a certain ſpace of time, in hot climates fifteen days, in cold ones a month, and ſo proportionably, at the end of which it is transform'd into a very large moth, and works it way out by an hole which it makes through the ball.

The male and female moths then couple, and when they are ſeparated, the female lays her eggs to the number of three or four hundred, and in a few days afterward both males and females die.

Their eggs are kept ſafe till the enſuing ſpring, at which ſeaſon they are again hatch'd into worms. This is the general ſketch of a ſilkworm's life when it is preſerved to breed; for millions of ſilk-balls are wound off to manufacture before the moths ſpoil them by boreing their way out.

While the ſilkworms are very young, they take up but very little room, and during the firſt fortnight at leaſt, may be kept in ſhallow broad drawers, boxes, and ſuch like, and that in great numbers; for a foot ſquare may contain above ten or twelve thouſand of thoſe newly hatch'd, but as they grow larger, ſo muſt alſo the ſpace that contains them. Thoſe therefore who have large nurſeries of ſilkworms, ſhould provide a place large enough to hold them when at their greateſt ſize; a foot ſquare will not contain above an hundred worms conveniently, when they are full grown.

As to the temperature of the place in which they are kept, cellars and all moiſt places are to be avoided, nothing being ſo great a detriment to their thriving and health as moiſture; high places, ſuch as thoſe next the tiles of an houſe, are alſo to be avoided, for here they would be too hot in warm weather, and too much chilled in cold weather; an equal degree of heat is what beſt agrees with them, and that heat always from a dry and not a moiſt air. The temper of the climate is therefore to be regarded, ſo as in hot climates

mates to avoid violent heats, and in temperate ones great colds, and in both moiſture.

The room in which they are kept ought to have windows oppoſite one another, that is to ſay on the Eaſt and Weſt, or on the North and South, ſo as that, by opening the oppoſite windows during very hot weather, the air may have a free current through, in order to refreſh and clear the place of bad air or ſmells. Theſe windows, provided they ſhut cloſe, may be made either of thin canvaſs, which is beſt in warm climates, or of glaſs, oiled paper, tranſparent membranes, or any other material which will prevent the cold and admit light; and it will be neceſſary to have nets, or ſomething of that nature, to prevent the entrance of birds when the windows are left open, which might make great havock among the worms, unleſs you only open them while you are preſent. No bad ſmells, ſuch as thoſe of ſmoak, ſewers, or ſuch like, ſhould approach their lodgment; and all creviſes which might admit or harbour rats, mice, ſnakes, ſpiders, crickets, or other vermin ſhould be cloſe ſtopped, for ſpiders and other ver-

min will prey on them while very young, and ſnakes or lizards at any age.

Under the foregoing conditions, it is no matter what ſort of building they are kept in, a mud-wall tenement is as good as any, nay on account of its dryneſs perhaps preferable to any other; the barns and other out-houſes of farmers may be uſed for this purpoſe; or, in hot countries, occaſional ſheds may be made, which, in ſuch climates as ſome of our colonies enjoy, will ſufficiently anſwer the end; for the reader muſt here take notice, that ſeveral circumſtances, which will be mentioned in the courſe of this inſtruction, are rather conveniences for thoſe that would do things in the neateſt manner, than abſolutely neceſſary, and that many of the precautions againſt cold and wet will be uſeleſs in ſome climates. Thoſe circumſtances which are abſolutely neceſſary to be obſerved, the practitioner will, from his own experience, ſoon diſtinguiſh from thoſe which are not ſo material, or which the nature and conveniences of the country determine him to make choice of; and the courſe of his practice will alſo make him ſupply what may haply be forgotten among a number of minute and various circumſtances.

CHAP.

CHAP. II.

Of chooſing good eggs, and the time of the year proper to hatch them.

THE way to be certain of having good eggs of your own breed will be ſhewn further on in Part III. but if you are only beginning to feed ſilkworms, and are obliged to buy your eggs, you muſt, in a great meaſure, depend on the honeſty of the ſeller, eſpecially if you ſend for them to a diſtant country; the principal rule to be depended on in this caſe is, for the buyer to chooſe the largeſt and moſt plump eggs, and of a lively blueiſh or grey colour, for if they are ſmall they are of a weak and puny breed; thoſe that are white or yellow have been laid by the female without coupling with the male, at leaſt are not impregnated, and therefore good for nothing; and thoſe that are brown, ſhrunk, and very flat are decay'd. If you are near the place where the eggs were bred, you can beſt diſcover their ſize and goodneſs, before they are taken from the

materials on which they were laid by the moth.

Some give as one mark of good eggs, that they ſhould make a noiſe in cracking them with your nail, and that the moiſture that comes from them ſhould not flow thin, but theſe are no certain ſigns. Some are ſaid to kill good eggs by the heat of the fire, in order to hinder the propagating them in other countries; and at beſt, it is to be feared that many who make ſale of them are not very careful of the breed, but take them indiſcriminately from weak as well as ſtrong worms. Beſide the choice of good eggs, ſome regard is to be had to the climate in which they are to be rear'd, ſo as to buy your eggs from a country which enjoys nearly the ſame degree of heat; or if any difference is to be made, I would rather buy them from a country a ſmall degree colder than the one to which they are brought.

It is alſo to be obſerved, that you muſt not put more eggs to hatch than you can procure mulberry leaves to nouriſh them with; it is hard to give a rule for this; three or four large trees, or about a dozen or fifteen ſmall ones may feed about an ounce

ounce of eggs, if they are the white mulberry, but if you uſe the black, its leaf being much more groſs and broad, you may reckon one of the black equal to two or three of the white ſort. The beſt precaution is rather to have too many trees, than too great a number of worms.

Being furniſhed with eggs, the next thing to be regarded is the time of hatching them; and the beſt and ſureſt rule for this is, to do it when you ſhall obſerve the mulberry buds begin to open and ſpread into ſmall leaves; and it will not be ſufficient to obſerve this in one or two trees, which may chance to ſtand in a warm and ſheltered ſituation, but it muſt appear through the bulk of all your trees, otherwiſe, though you may have a great number of trees, you may be diſtreſſed for want of food; for though ſome have taught to ſupply this defect with lettuce, and other different kind of leaves, as elm, mallow, bramble, roſe and nettle leaves, yet it is not worth while to amuſe one's ſelf with rearing worms which have taken their firſt nouriſhment from any of theſe, as they will neither be ſtrong nor make good ſilk. The bramble or blackberry has

has been preſcribed, becauſe its fruit reſembled the mulberry, but the flavour of the leaf has not the leaſt affinity, being auſtere and ſtyptick, whereas the mulberry has a mild ſweet taſte, with a peculiar flavour, and the others have been preſcribed perhaps, becauſe the worms, to avoid being famiſh'd, would eat them. But as each particular ſpecies of caterpillar has its peculiar plant allotted for food, ſo the ſilkworm has the mulberry, which alone it willingly eats, of all plants or leaves yet tryed; neither do other caterpillars willingly eat the mulberry that I have heard of; I tryed the ſpeckled hairy worms that feed on the nettle and ſeveral others, but they would not touch it. I once indeed met with a green worm, about an inch long, and as thick as an oaten ſtraw upon the mulberry-tree; I fed it in a box with the leaves of the mulberry; it was very nimble and wary, it changed into a ſmall brown-winged moth; I believe, as it was ſingle, it was not a native of that tree, but came there by accident.

Theſe things being conſidered, I think the ill conſequences of giving the worms any thing for food but the mulberry-leaf will

will appear, and I ſhould rather chooſe to give up thoſe worms, that were hatch'd before there were leaves, for loſt, and begin a new hatching of eggs, than attempt to feed them with any other thing than the mulberry, unleſs it were for two or three days, and even this, only when I could procure no more eggs that ſeaſon.

But even the neceſſity of doing this may be prevented; for if you fear that your eggs ſhould hatch before the mulberry-leaf comes out, remove them into a cooler place, and this will backen them for ſome time. Or if it is found neceſſary to keep them very cool in any of our colonies, in order to prevent their hatching too ſoon; they may be put into a bottle with a pipe fix'd in its neck, and then the bottle may be kept under water or in a well, the mouth of the pipe muſt be above the water, to admit freſh air, and it ſhould be coated well with wax, at the place where it is fixed in the bottle, to prevent the entrance of the water. I have tried this with a ſmall bottle of eggs kept in a veſſel of water, and it has kept them from hatching for three weeks, after others had hatch'd of themſelves; yet perhaps very cold ſpring wells

wells might deſtroy the viviſying principle of the eggs, eſpecially if the weather was already grown very warm, and they had a tendency toward hatching, the change then from heat to cold might be too great: the experiment may at firſt be made upon a ſmall quantity of eggs. The bottle need not be above half fill'd with eggs, that a larger ſurface of air may be in contact with them; and it ſhould be loaded with ſome weight, and the pipe buoyed with cork in ſome part, anſwering to the depth you would have it ſink in the water.

If your eggs had began to hatch before you took this precaution, you muſt then proceed directly to hatch them, by putting them in ſhallow boxes, as mentioned in the next chapter but one; for you muſt not put them in bags becauſe it would now hinder their coming out by their lying in an heap. And now as they hatch you may feed them even with the ſmall buds of the mulberry though not yet opened; this indeed makes ſome waſte of their future ſuſtenance, but if you have plenty of trees it is not much matter, as the worms now eat but a ſmall quantity.

Even

Even the green bark ſcraped from the branches will feed them, but this injures the trees, if it is ſcraped with an iron knife I ſuſpect that it might give an aſtringent quality to the bark which would hurt the worms, one of glaſs or a ſharp flint would do beſt. It would be proper, if the climate is liable to thoſe inconveniencies which ariſes from a late ſpring, blaſts or ſharp winds, to have a good many trees in a ſunny place, but ſheltered from the ſevere winds, which may give you food for your worms as early as is neceſſary, and by the time that theſe leaves are uſed the other trees will be ready; but if the lateſt trees are ready time enough, it would then be beſt to preſerve theſe early trees to the laſt, when the worms are full grown.

Beſides obſerving the budding of the mulberry-tree, you ſhould chooſe a day clear, dry, and warm, when you put your eggs to hatch: ſome alſo adviſe that you ſhould, if in other reſpects convenient, chooſe the new moon, in order that the worms may begin to ſpin on the full moon of the following month, which they think makes them ſpin the better; but as in very warm climates time is chiefly to be gain'd,

that the worms may be rear'd before the weather grows violently hot, which is very apt to injure them; therefore the earlier you begin will be the better, without regarding the influence of the moon; beſides, as in ſome climates you may rear two broods in one ſummer; this is another reaſon that you ſhould begin as early as you can, that your ſecond brood may have finiſh'd their buſineſs before the weather begins to grow cold.

Having fixed upon your time of hatching, obſerve that all thoſe directions which follow, concerning the manner of doing it ſhould be purſued in a chamber well cloſed, and ſecured from cold and wind; and obſerve that the bags and boxes which ſhall be hereafter mentioned for putting the eggs to hatch in, ſhould be made as warm as your ſkin before you do this; and when you uſe the boxes they may be lined with a piece of ſilk or cotton ſtuff.

If the weather ſhould happen to grow cold or moiſt, after you have begun to hatch your eggs, you muſt be more careful to guard againſt the injuries of it: you muſt continue the ſame degree of warmth as near as you can, and not remit

of it, unleſs it be a very little after your eggs have begun to hatch, and this only to avoid erring on the extreme of too much heat, which would at that time injure the worms which were hatched or near hatching.

CHAP. III.

The method of hatching the Silkworm's eggs.

THE nature of the ſilkworm's eggs is ſuch, that like thoſe of other inſects, they will as the weather advances in warmth hatch of themſelves; but as, in this manner, there would be a great diſtance of time between thoſe that hatched firſt, and thoſe that hatched laſt, inſomuch that, as ſome would every minute be hatching, it would be impoſſible to attend or collect them together, or afterwards to feed them, on account of their being ſick at different times; therefore it is neceſſary to make uſe of artificial warmth in order that numbers may be hatch'd at one time, and that your whole quantity of eggs may come out at leaſt in two or three days, ſo that you may be

be able to ſeparate each days hatching, or rather two or three times a day, and feed them by themſelves. And this is a thing ſo abſolutely neceſſary, that without it there would be no poſſibility of feeding any quantity of ſilkworms to advantage, as I ſhall ſhew hereafter.

Various methods of making the eggs hatch may be uſed according to the conveniences of people; but whatever method is uſed ſhould aim principally at this end, viz. of making them hatch as nearly as may be together. And the thing that will moſt effectually do this is an equal degree of warmth, as near as can be attained, and conſtantly apply'd till they are hatched.

This degree of heat, which is called the heat of incubation, is that which the ſkin of a healthy perſon can communicate, or any other heat equal in degree to it. And the method for hatching them by this heat is as follows.

Divide your quantity of eggs into parcels of one or two ounces each, and put each quantity into a bag of cotton, ſilk or ſtuff, tying it ſo as it may not ſpill: theſe bags are to be kept in the breaſts, next the ſkin, by a perſon who do not uſe violent

violent motion, or who might otherwiſe endanger them by cruſhing or ſqueeſing them too hard, this they do for the ſpace of two or three days, or until they ſuſpect that the eggs are within a little of hatching; which, if the eggs were not too forward before, will be in the ſpace of three days and nights; at night the bags are taken into bed with them, but care muſt be taken not to cruſh them, and therefore it would be well, having firſt warmed the bolſter thoroughly as warm as the ſkin, and taken care that the outſide be not hotter than that, to lay the bags under it, placing over them a ſmall box or drawer, ſufficient to hinder them from being cruſhed, with its bottom uppermoſt.

When the eggs are ready to hatch, which will be about the end of the third day, it is inconvenient any longer to keep them in the bags, becauſe the worms which hatch'd would be ſqueezed and hurt as they came out; and therefore each parcel muſt now be gently poured out into a ſhallow box, of ſuch a breadth as that the eggs ſhall not lie on the bottom above a quarter of an inch thick, ſo that the worms, as they hatch, may be able to make their way

through. The box ought to be of clean firr, ſuch as wafer boxes or the like.

The eggs of different bags ought not to be mixed, becauſe they may have received different degrees of heat and ſo would hatch unequally. The beſt time of putting the eggs into theſe boxes is juſt before you go to bed, that you may put them under your bolſter warmed as was before directed; covering the box cloſe with its lid, which lid ought not to come ſo cloſe to the eggs, but that there ſhall be ſufficient room to lay the ſliced leaves of the mulberry over the worms when they begin to hatch.

The next morning early, after having put your eggs into this box, open it, and, if the worms have not yet begun to come out, return the box under the bed-cloaths, where they may remain about two hours after you have left the bed, for about ſo long a ſufficient heat will remain; after which the boxes muſt be placed between two pillows heated very moderately, for a ſmall over-degree of heat would injure the worms when near hatching, and you muſt have other pillows ready warmed, as theſe cool, and ſo continue them, all day be-

tween pillows, and at night in your bed, till they begin to hatch.

In warming the pillows you may place them as near the fire, and heat them as quick as you pleaſe, and let them be heated thoroughly; but take care, before you place your boxes between them, that they may cool ſo as to be no hotter than your hand when thoroughly heated in your boſom, and to preſerve this heat, the longer in the pillows, you may wrap round them a quilt or coverlet, the thicker it is, the better, and this may be heated as hot as you pleaſe, it cannot injure the worms through the pillows.

Where large quantities of eggs are to be hatched, ſeveral pillows may lie upon one another, and be faſtened by a couple of ſtrings, tying them acroſs, and may then be placed at ſuch a diſtance from the fire as that the heat exceed not that of the human ſkin; this diſtance you may find by warming your hand in your boſom, and approaching it towards the fire till you juſt begin to feel the warmth, here fix the ſtack of pillows with the boxes, and place a quilt or ſuch like behind them, to hinder the back from cooling too faſt, and thus

turning the whole ſtack now and then, to give all parts an equal degree of heat, you will ſave the trouble of often changing and warming the pillows. Or inſtead of placing them before the fire, you may, when the ſun ſhines clear, place the ſtack of pillows in the window where the wind doth not enter, and hanging a coverlet behind them, turn them as before, which, while the ſunſhine continues, will ſufficiently preſerve their warmth; the boxes ſhould ſink into the pillows, ſo as to have all ſides compleatly covered; and when you ſuſpect the eggs to be near hatching, you may, every three or four hours, ſlip different boxes out to try them, taking care, as often as you do it, to expoſe the eggs as ſhort a time as poſſible to the cool air.

The method of hatching the eggs in bags by the heat of the ſkin might perhaps be improved, by putting the bag into a box fitted to its ſhape, but rather a little ſmaller, that ſo it may keep ſteady; which it will the better do if the bag is made ſo deep that its mouth may be turned outward over the rim of the box; this will alſo keep the lid of the box firm, and hinder the new hatched worms from creeping between the bag and

and the box which contains it. But as air is neceſſary for the hatching of eggs, the box ſhould be all over pierced full of ſmall holes, and the bag ſhould be made of thin ſilk or ſtuff.

The eggs thus inclos'd may be kept in the boſom, or by men in pockets made on the inſide of their waſtecoats, or in any other way near the warmth of the ſkin, without ſuch danger of cruſhing as when kept in bags alone; beſides, as the eggs ſhould not quite fill the box, they may, by turning it ſoftly round, be ſhifted and mix'd ſo as to enjoy an equal degree of heat; and when they are put under your bolſter at night, there will be no fear of injuring them: but, when the eggs are near hatching, they muſt be pour'd into the broad ſhallow boxes; and treated, in all reſpects, as thoſe poured out of the bags into ſuch boxes.

Some, without putting them at all into bags, hatch them from the beginning between pillows in ſhallow boxes, keeping them by day between the warmed pillows, and at night in bed, or under the bolſter in the manner which has been already related. The eggs while in the boxes, may

be ſometimes ſtirred and mix'd, with a ſmall ſpoon made of wood, that they may equally ſhare the heat which is uſed in hatching them: the boxes may be near full of eggs till they begin to hatch, after which the eggs muſt be ſpread thin in other boxes.

Many authors direct the ſteeping of the eggs, in wine made as warm as the ſkin, for half a quarter of an hour, and then drying them in a moderate warmth, by gently rubbing them in a dry napkin, juſt before they are put to hatch. This makes them come out more equally together, for they, at this time, ſeparate thoſe eggs which, after having been half a quarter of an hour ſtirred in the wine, ſwim at top, and throw them away, or at leaſt don't mix them with thoſe which ſink; becauſe they are of a weaker conſtitution, and would not be likely to hatch ſo ſoon. This method alſo ſeparates thoſe which are decayed and rotten, which may be of good uſe if, as is ſaid of pullets eggs, the rotten ones will affect the reſt.

I have been the more particular on this circumſtance of hatching the eggs, as it is one of the moſt neceſſary points in breeding ſilkworms, yet notwithſtanding the many

and

and minute things which are set down, the practice will be found sufficiently easy; I shall only add that in some of our hot colonies, heating the pillows, and afterwards managing them by the meer warmth of the sun, in the day time, and at night in bed, by the method before prescribed, may be found sufficient to hatch the eggs effectually; but to expose them naked to the hot sun, I take to be a very bad method in any climate, the heat being too great, and neither equally imparted nor equally continued. I shall now proceed to the management of the worms when they begin to hatch.

CHAP. IV.

The method of treating the Silkworms during the time of hatching.

WHEN the worms begin to hatch, you should have in readiness two pieces of paper, fitted to the inside of each hatching-box, pricked full of holes as big as a large pin would make. Lay these two papers over one another in each box,

and ſtrow over them ſome mulberry-leaves, ſliced into ſhreds, ſo as to cover the whole ſurface; then ſhut the box and lay it in your bed if warm, or between the warmed pillows, the heat of which ſhould now be rather more moderate than before, for fear of injuring the worms; the box alſo would be the better for having a few holes in its lid to admit freſh air.

The worms, as they hatch, will come thro' the holes of the paper and fix upon the leaves, and when you perceive them almoſt quite black with worms take off the upper paper, and gently ſlide the leaves, with the worms which adhere to them, upon the place where you intend to keep them. Or you may with a large pin take up the fibres in parcels, and ſo ſpread them; but don't ſpread them thinner than juſt that they may not lie in heaps upon one another. I have practiſed an eaſier method than either of the foregoing, for ſhifting the worms of the pricked paper, which is to hold it inclined in one hand, and, bringing the ſurface of another peice of paper cloſe to the worms and fibres, gently to turn them over, and ſo the pricked paper lieing uppermoſt may be taken away,

and

and placed in the hatching box, as before, for freſh worms to come on it.

The reaſon for uſing two prick'd papers to each box, is to avoid taking up the eggs when you remove the paper; for many of them are apt to ſtick to the paper which is next them, by a fine cobweb which the worm begins to ſpin the inſtant it is hatched. Two pieces of gauze or cyprus, wove wide enough to let the worms paſs, would ſave the trouble of pricking the papers, and do better, eſpecially, if by means of two or three ſhreds of fine hay, their ſurfaces did not lie exactly cloſe to one another; this alſo ſhould be taken care of when you uſe prick'd paper, otherwiſe the holes of the upper paper, by lying cloſe to the under one, might not afford a paſſage to the worms to come through. In this manner you muſt continue to manage your worms until they are all hatched, you ſhould viſit your boxes at leaſt twice a day, in the morning early and at ſunſet, if your worms hatch faſt you may do it thrice; and be ſure not to mix thoſe that hatch at different times together; this would create you an infinite trouble in your future management of feeding and cleaning them, on

account of their moulting-ſickneſs coming on at different times. If you keep the hatchings of every ſix hours diſtinct, provided they come out faſt enough to cover the leaves in that time, you will have the leſs trouble afterwards; but thoſe of twelve hours diſtance muſt never be mixed together; wherefore number the drawers or papers into which you put them, according to their different times of hatching, that you may not afterwards miſtake.

The greateſt number of worms are generally found hatched early in the morning, and may then lie too thick on the leaves, ſo as to croud one upon the other; in this caſe, when you diſtribute them into the drawers, place the heaps that you take out of each hatching box at ſome little diſtance from one another, and lay ſome freſh mulberry leaves between them, that the worms may ſpread themſelves, and not be crouded. The rule for which is, that they ſhould nearly cover all the leaves, ſo as to make them appear almoſt quite black, but not lie upon one another; if they lie thinner than this, they will not have eaten their leaves before you give them the ſubſequent feeding, and ſo will remain among the

the old ſhreds, not coming up readily to the freſh leaves, by which means the leaves will alſo grow withered before they are quite eaten, and thus continually heaping leaves, you will both waſte their food, and bury many of the worms under the heap of fragments. Note, for the firſt eight or ten days of the worms age, let the leaves always be ſliced. In two or three days, if things have been managed well, your eggs ought all to be hatched; but if you have not as many hatched on the third day, reckoning from the time of their beginning to hatch, as you intend to feed, you muſt continue to keep the eggs warm as before.

Some, to avoid tedioufneſs in getting their quantity of worms hatch'd, put a conſiderable greater quantity of eggs to hatch, than they intend to feed, and then in a day or two from their firſt coming out they have all their number, and not ſo many different ages among their worms as they would otherwiſe have had. What eggs remain after this may either be given to ſomebody elſe to continue their hatching, who might happen to want eggs, or elſe ſhould be thrown away. A few eggs extraordinary are of little value, and what

are

are thrown away are ſtill of leſs account, as the weakeſt worms are likely to be the laſt coming out: manage what way you will, there will always be ſome which come out ſo late as not to be worth attending on, as alſo ſome very early ones, but ſo few in number as not to deſerve a diſtinct drawer or place of feeding; both theſe may be thrown away.

I have here all along mentioned the putting your new-hatched worms in ſmall drawers or boxes; for though hereafter I ſhall give directions for making large ſtands to feed the ſilkworms on, yet theſe need not to be uſed till the worms have at leaſt paſſed their ſecond moult, or ſleep as it is called; this is to be underſtood of worms bred in the more temperate or cool climates, ſuch as *France* or *England*; for in the hot climates, ſuch as *Georgia* and others of our colonies, they may in fine weather bear the open air ſoon after they are hatched, and be laid upon papers ſpread on the large hurdles, or on an open table, with only ſome ſlight covering of paper thrown over them for the firſt days; but if it is cold weather, drawers will be found very convenient, as they can beſt regulate the neceſſary

neceſſary degree of warmth. I will ſuppoſe you have a frame containing ſix drawers one over the other, and that each drawer is about an inch in depth, and twenty inches by twenty ſquare; there will then be nearly the ſpace of three ſquare feet in each drawer: I will alſo ſuppoſe that one ſquare foot will contain all the worms that are produced from an ounce of eggs when juſt hatched.

Suppoſe now you were hatching three ounces of eggs, of which you intend to make three different ſortments, as coming out at three different times, an ounce each time; then the firſt ounce that hatches ſhould be put into the middle of the uppermoſt drawer, and marked as the firſt hatched; it will in this drawer take up the ſpace of one ſquare foot, and there will be the ſpace of two ſquare feet left in the drawer, which will be occupied by the worms by the time they have paſs'd their firſt moulting. The ſame is to be underſtood of the ſecond hatched ounce, which ſhould be put into the third drawer; and of the third hatched ounce, which ſhould be put into the fifth drawer. When the firſt hatched worms have grown to the ſize of their drawer,

drawer, half of them muſt be placed in the ſecond drawer, and they will fill both theſe by the time they have paſſed their ſecond moult; in the ſame manner the ſecond hatched will fill the third and fourth drawers, and the third hatched will fill the fifth and ſixth, and then they may be diſtributed upon the large ſtands.

Thus you ſee the ſix drawers will contain all the worms which come from your three ounces of eggs, without confounding different hatchings. I ſuppoſe that the worms will occupy thrice the ſpace after each moulting that they occupied at the moult foregoing, which I believe is pretty nigh the truth, and will hold through all the different moults, and alſo from the fourth moult to the time of their ſpinning; and I have run through this method only as a ſample of the regularity which, in ſome degree, ſhould be uſed through the whole proceſs of feeding ſilkworms, when they are hatched at different times.

The drawers above-mentioned may be made of any ſlight materials, ſuch as laths, with paper bottoms, ſupported by two or three ſtrings or ſticks, to hinder the paper from ſwagging; or they may be made of

ſtraw

ſtraw ſmeared with cow-dung and dried, as beſt ſuits the climate and your conveniency.

The frame which ſupports the drawers need be only four uprights, with croſs bars for the drawers to run upon, being open on all ſides, that the freſh air may occaſionally have acceſs, for which reaſon alſo there ſhould be an inch or more diſtance between each drawer; a cover of coarſe ſtiff paper may be made to go over the whole, and keep the young worms warm when there is ſharp weather; and one ſide of this cover may be looſe, ſo as to throw back when a leſſer quantity of freſh air is neceſſary, and you do not care to uncover the whole frame.

This neſt of drawers can eaſily be moved from one part of a room to another, can be ſecured from cold by covering it cloſe at night, and alſo from mice or other vermin, by hanging it out of their reach.

I mentioned above the laying of the worms in the middle of the drawer, the reaſon of which is, that they may regularly ſpread themſelves, ſo as to fill the whole drawer as they grow large; they are made to do this by ſpreading the leaves a little

a little round them as you feed them, and perceive that they lie too throng, for the worms will follow the leaves that are laid close to them. The same may be effected, by making three or four different parcels of the worms in the same drawer, and so feeding them till they meet.

Thus much was necessary to be said here concerning the management of the new-hatched worms; but before I proceed farther in the method of feeding them, it will be convenient to give an account of the stands which are to keep them as they increase in size. The manner of gathering the mulberry leaves, and their periodical sickness, which I sometimes call moulting, because they then cast their skins, and are disordered like birds that are casting their feathers. These are the subjects of the three following chapters.

CHAP. V.

The manner of preparing the large ſtands and ſhelves on which the grown ſilkworms are to be fed, and on which they afterwards ſpin their ſilk.

IT will be convenient for thoſe who feed large quantities of ſilkworms, to have the ſtands and ſhelves on which they are to be kept, or at leaſt ſome of them, prepared before they are abſolutely wanted, in order to avoid being hurried when they become neceſſary; and thoſe who are provident will prepare them in ſuch a manner, that the ſame materials can every year be quickly and eaſily put together and refitted, and when there is no further occaſion for them, taken aſunder and laid by in ſmall room.

The ſtands (ſee plate I. fig. I.) are made by erecting poles about an inch and half thick, according to the weight of ſhelves and worms which they are to ſupport; they are placed at the diſtance of three or four feet aſunder in a ſquare ſituation, and are ty'd firm to long ſtreight tranſverſe

poles reaching from one to the other, ſo as to form partitions for the ſhelves where the worms are fed. The ſhelves muſt be fourteen or more inches aſunder, and their ſize not more than that, when you are on one ſide, you can reach half way over, in order to give the worms their leaves, and attend them, and then going on the other ſide, you can reach to thoſe which are fed; therefore each ſhelf ought not to exceed four feet in breadth.

Thus the ſhelves on which the worms are to be fed, form ſtories one above another in theſe ſtands; they are hurdles compoſed of reeds, ſmall oziers, and ſuch like. The hurdles made of ſmall reeds are preferable I think to boards or any other ſhelves, on account of their cheapneſs, lightneſs, and dryneſs, and alſo for other reaſons, which will appear in treating of the manner of feeding and cleaning the worms.

If the hurdles are made ſo as to let the litter drop through, there might be a receiver of coarſe paper to hinder it from falling on the leaves and worms of the next lower ſtory; theſe receivers may be fixed ſo as either to be brought up cloſe under the hurdle, or to let down on one ſide,

ſide, ſo as to form a ſlope when you would ſweep away the litter that has gathered on them. But becauſe the fixing of theſe receivers may appear too troubleſome to many, it may ſuffice to make the hurdles of reeds placed ſo cloſe to one another, that after the worms are a fortnight old, none of their litter can paſs through; and before they arrive at this age, they may have paper or other convenient materials ſpread under them on the hurdles, which will hinder their litter from annoying the lower ſhelves, and alſo be convenient in taking out each ſheet of paper by itſelf when you would examine or clean the worms, unleſs you keep them in drawers, as taught before.

Hurdles ſeem much preferable to ſhelves of boards; for though when the worms are large and make much litter, their hurdles muſt be taken out, ſhaken, and ſwept, yet this need not be done near ſo frequently as when they are kept on boards; for the air, which will have admiſſion through the vacancies of the reeds, will keep them ſweeter, by drying the litter and alſo the ſhreds of leaves that remain on them, and will hinder them to grow ſo moiſt and

mouldy as they would be apt to do on boards, where the air could have no admiſſion from beneath; for any great moiſture and mouldineſs of the heap of litter on which they lie muſt always be guarded againſt, and their hurdles cleaned as often as ſhall be found neceſſary.

If you are ſtinted in room, your ſtands may be raiſed ten foot, but then it will be neceſſary to have a ladder, in order to be able to feed the uppermoſt ſhelves; and this ladder ought not to lean againſt ſuch ſlight materials as theſe ſtands are compoſed of, but ought to ſupport itſelf with two ſtriding legs, like thoſe uſed to clip high hedges; and therefore it will be beſt not to have your uppermoſt ſhelf higher than that you may, by ſtanding on a ſtool or bench, reach your hand to feed the worms, unleſs, as was before mentioned, you were ſtinted in room; for which reaſon, though you may make your upright poſts ten foot high, you need put no ſhelves higher than neceſſity ſhall from time to time oblige you to do, the low ſhelves being eaſieſt attended.

Several rows of theſe ſtands may be placed in a room, leaving alleys between each

each row of them, ſo broad as that two perſons, in feeding the worms, may paſs one another when they meet, and alſo room to take out the hurdles. Some adviſe to make each hurdle narrower than the next loweſt, in order that the worms which chance to drop from one ſtory may be caught by the next; but this would loſe a great deal of room; the worms, until they are ready to ſpin, never wander from the leaves, and may eaſily be ſecured.

Thoſe who have no great nurſeries of worms, or want the means of making ſuch regular conveniences as I have deſcribed, content themſelves with nurſing the worms in the room where they lodge on all ſorts of boards, ſhelves, tables, wicker hurdles, &c. fixed in whatever manner is moſt convenient; and the worms do well, provided they are guarded againſt rats and other vermin, and creatures that might prey upon them or diſturb them; nor are they hurt by the frequency of people, nor by moderate noiſes, if they are accuſtomed to them, but ſhocking, harſh and ſudden ſounds ſhould be always avoided: but though this ordinary way of keeping them may do, it will ſtill be beſt to

keep them in the moſt convenient manner, it will abridge and methodize the trouble of feeding and cleaning them, and this being a great part of the labour attending ſilkworms, every thing that ſhortens or eaſes it, whether by what I have or ſhall hereafter mention, or by what the practitioner ſhall himſelf find out, is to be conſidered as a material point.

Plate I. Fig. I. ſhews the ſtructure of the ſtands where the ſilkworms are to be fed when they grow large and require much room. It is a ſort of ſcaffolding compoſed of ſtreight poles tied together. Its breadth A D three or four feet; its length A C may be continued according to the dimenſions of the room which contains it; its height A E about five feet, unleſs you are ſtinted in room, and then it may be as high as the ceiling.

The upright poles A E. D F. &c. ſhould be niched where they are tied at top, in the manner repreſented at Fig. II. to let the tranſverſe poles A B C, &c. into them, that the ſcaffolding may ſtand the firmer; but at bottom the tranſverſe poles E G I, &c. ſhould be niched, and not the uprights, becauſe

becauſe, as they ſuſtain the whole weight, it might weaken them.

When you untie the ſhort tranſverſe poles A D, &c. which are at the ends of the ſtand, the front and back of the ſcaffolding comes aſunder, and may be laid flat againſt one another, ſo as to take up little room, till you have occaſion again to uſe them. The diviſion next A ſhews the ſhelves, which are a ſort of hurdles made of ſmall reeds. They are ranged above one another at about the diſtance of fourteen or fifteen inches.

Over the loweſt hurdle is repreſented a ſloping receiver of coarſe paper, or thin baſs matting; its uſe is to defend each under hurdle from the litter of the worms above it. Theſe are only neceſſary when you chooſe to weave the reeds ſo open as to let the ſilkworms litter fall through; in which caſe there ſhould be a receiver under each hurdle; but when the hurdles are made ſo cloſe as not to let the litter paſs, there is no occaſion for the receivers.

The diviſion at B is left clear of ſhelves, to ſhew the pins 1, 2, 3, 4, 5, &c. upon which the hurdles reſt; the breadth of each hurdle muſt be equal to the diſtance

between the upright poles, that it may eaſily be put in and taken out; but its length muſt be three or four inches more, that it may reſt ſecurely on the four pins which ſupport it. It may be inclined to one ſide when taken out or put in. The branches, for the worms to ſpin at the diviſion C, &c. will be deſcribed in Part III.

Fig. III. repreſents one of the hurdles compoſed of ſmall reeds, its rim made of four ſtrong reeds or ſticks tied together at a, b, c, d, where two nitches, ſuch as that of Fig. II. are let into one another. This kind of curved nitch is not apt to break, nor doth it weaken the part, as an angular one would do. The ſtrong reeds or ſticks e, f, g, over which the ſmall ones are woven, may be tied in the ſame manner. The ſmall reeds are woven in parcels of twenty or thirty, and cloſe to one another, when you intend that the litter of the worms ſhould not drop through, yet there will be ſtill ſpace enough between them to let the air paſs.

CHAP. VI.

The manner of gathering the mulberry leaves, and keeping them freſh.

THE hands of thoſe that pull the leaves ſhould be very clean, as alſo of thoſe who attend and feed the worms; they ſhould not have handled any thing that has a ſtrong offenſive ſmell, ſuch as leek, garlick, and ſuch like; neither ſhould they have eaten them, nor uſe tobacco, eſpecially in ſmoaking, when they feed the worms.

The time in which they ſhould pull the leaves, ought to be as ſoon as the dew is off them in the morning, for they ought never to be pull'd with moiſture on them. As the worms ought to be fed with leaves which are tender and young, in proportion to their tender age, therefore you ſhould begin by pulling one tree regularly after another; you muſt not begin to pull a ſecond tree till you have pull'd all that you ought to do of the firſt, for you muſt not quite diſleaf a tree for fear of hurting it; nor muſt you pull the ſame tree twice, though

though by the time that you have pull'd a good many of your other trees, it ſhould have thrown out a conſiderable quantity of leaves, both becauſe it would injure the tree, and becauſe theſe leaves would be improper for the worms, being a ſecond growth and tender; whereas the worms will then be advanced in age, and require older leaves.

If your trees are kept in a flat form, being planted like an eſpalier hedge, you may begin regularly at one end of your hedge, and pull the leaves regularly on, making a mark every day as far as you have pull'd, that you may not go over the ſame part twice; and thus when you have gone in order down one ſide of the hedge, you return up the other, and ſo proceed to another hedge.

If the hedges run in lines from north to ſouth, pull the eaſt ſide firſt, becauſe in ſpring, when the ſun is weakeſt, it will be firſt dried after the morning dew; but as the ſeaſon advances in warmth, the weſtern ſide will be ſufficiently dried, though the ſun has not ſhone upon it when you begin to pull in the morning. It is beſt I think to have the hedges run from north to ſouth, that each ſide may ſhare the ſun alike; but

but if a ſhower of rain have driven with an eaſterly or weſterly wind, pull that ſide which lay to the leeward, as being leaſt moiſt.

In pulling the leaves it is much better to do it eaſy, taking the leaves in your hand, than to take the whole branch or ſhoot in the fiſt, and thus to rake off as many leaves as you can at once; for this both bruiſes the leaves, which makes them bad for the worms, and alſo breaks and damages the branches, and fills the leaves with ſhreds of broken boughs; wherefore one of the gatherers ſhould be a ſkilful perſon in feeding and managing the worms, and ſuch as can be truſted to direct and overſee the others; for as it is common to pay the gatherers by meaſure for the quantity of leaves they bring in, they will be apt only to make it as large as they can, without either choice or ſkill. The leaves as they are gathered ſhould be thrown into clean baſkets, and not too much ſtuffed or preſſed together, which would make them heat and otherways damage them; each gatherer ſhould have a ſmall baſket, which he may hang beſide him to the tree, by a hooked ſtick, that he may not be obliged

to

to ſtuff his hands too full before he empties them; and thus all the gatherers having fill'd their ſmall baſkets, may empty them into one or more large ones, in which they are to be brought home.

Such a quantity of leaves ought to be gathered each morning, as will ſerve to feed the worms during the reſt of the day, and alſo enough to give them their firſt feeding, early the next morning, before the new leaves can be gathered: after one or two feedings you will eaſily judge what quantity will be neceſſary for this, and give directions to the gatherers to fill their baſkets accordingly. The leaves which are brought home ſhould be kept in a cool place, but not in too great an heap: if they are young, and ſuch as are gathered for new hatched worms, they may be kept in a glaz'd earthen veſſel, as they then make but a ſmall bulk; and when they come to make a large heap, as they muſt for a great number of worms that are grown large, they may be kept in large wicker pinniers or baſkets, or even in the corner of a cool room for two days. It is accounted beſt not to feed with the leaves freſh taken from the

the tree, for they are good as long as they remain green and firm.

Though your general method of gathering the leaves may be as has been deſcribed, yet, if the weather tends to be rainy, you muſt provide at leaſt two days food, or in proportion as you foreſee the difficulty of gathering, which if poſſible ſhould not be in wet weather, eſpecially while the moiſture is actually upon the leaves: you may keep the leaves tolerably well for two or three days in a cool place, but you muſt take great care that they do not heat and grow mouldy, which would greatly injure your worms. If the leaves, therefore, any way tend to this ſtate, you muſt often turn, and give them air; ſpreading and placing them where there is a current of air, or on ſome of the hurdles of thoſe ſtands which may happen not yet to be employed.

Notwithſtanding the foregoing caution, it may often happen, that on the very morning when the gatherers go out, and when you have no proviſion for that day, but what they ſhall bring in, there ſhall fall rain, and wet the leaves: in this caſe you are under a neceſſity of having the leaves gathered;

gathered; they ſhould therefore ſhake the trees before they begin to pull, and if it is an hedge in the eſpalier manner, they may ſhake it with a forked pole without wetting themſelves, and thus they will throw off a good quantity of the moiſture; and for what remains, it muſt be taken off by ſhaking and toſſing the leaves between two dry ſheets of linen, and afterwards ſpreading and airing them as above; for no neceſſity ſhould force you to give them to the worms while any moiſture remains, it is better they ſhould faſt. The gatherers ſhould not ſtay till they had pulled their whole quantity, in this laſt caſe; but ſhould at leaſt ſend in a ſufficiency of leaves for one feeding, as ſoon as they have gathered them, that they may be ſufficiently dryed by the time they are to be uſed.

As gathering the leaves in moiſt weather is to be avoided, ſo is alſo the pulling them after they have born the ſcorching heat of the mid-day ſun; they might then be too deſtitute of ſap, and would be apt to wither, and grow unfit for the worms before they were all uſed.

The leaves of trees which grow in moiſt grounds, or where they are ſo ſhaded that

the ſun cannot ſhine on them, are bad for the worms; ſo alſo are all ſpotted, blaſted, and yellow leaves; and thoſe which are upon ſuckers, or other proud ſhoots growing from the trunk or principal branches, are only fit for newly hatched, or very young worms. Therefore you may pull all theſe ſorts at firſt, through your whole plantation, as long as they laſt; and then go regularly from tree to tree, as before directed; but obſerve that even the young worms, if they had been uſed to feed on firm leaves, would be kill'd by giving them thoſe which grew on ſuckers; ſo that if theſe are us'd, it muſt be at the firſt.

Some mulberry-trees are apt to have ſuch quantities of fruit, that it is difficult to pull the leaves without having great quantities of the berries mixed along with them; theſe, beſides that they are ſaid to be hurtful to the worms, will occaſion a great quantity of litter, and mouldineſs; and will oblige you to clean the ſhelves much oftener than would otherwiſe be neceſſary: you ſhould rather therefore avoid pulling ſuch trees as are thus loaded with fruit, if you have enough without them; or, if you are obliged to uſe them, you ſhould ſeparate the

berries,

berries, if they are in any great quantity, by ſhaking the leaves in wide meſh'd ſieves or ſome ſuch way: but if you ſpare pulling ſuch trees, the berries will give you ſeed for new plantations; for if they are ſtripped of their leaves, the fruit will not ripen well nor grow large,

Beſide the foregoing obſervations, the gatherers muſt be cautioned not to bruiſe the leaves either by pulling them roughly, ſqueezing them in their hands, or preſſing them into the baſkets; not to break the branches of the foregoing year, nor mix the fragments of broken branches among the leaves. In ſhort, to injure the trees as little as poſſible, and to pull the leaves with clean hands, and bring them home in as neat a manner as they can. Not that it is abſolutely neceſſary to follow minutely every thing which is above mentioned; but if your conveniency anſwers, you will find them of advantage.

Some authors ſay that if the leaves are pulled by ſtripping them downward, it will diſbark and hurt the branches; but I have found that this is not fact, for they come off by ſtripping downward much eaſier than upward, and without injuring the

the bark, or being ſo much bruiſed by the hard graſping, which you are forced to uſe when you ſtrip them upward, which makes them leſs agreeable to the worms, you muſt however take hold of the end of the branch with one hand when you ſtrip downward.

CHAP. VII.

Of the four ſickneſſes or moultings which the Silkworm undergoes.

THE ſilkworm is ſubject to four ſickneſſes, from each of which it recovers by what I ſhall hereafter call moulting, or throwing off its ſkin; and the times in which this happens are carefully to be obſerved, together with the different appearance, which the worms makes both at the time of its ſickening, and after it has moulted; becauſe theſe are periods which greatly regulate your conduct in managing your broods.

The times of their ſickneſs are ſo variouſly ſet down by many different authors, that ſcarce any fixed times can be taken

from their accounts, eſpecially for the firſt ſickneſs, ſome fixing it to the ſeventh or eight day after hatching, and others not till the twelfth: but *Malpighius*, in his accurate anatomy of the ſilkworm, ſays that thoſe worms which he hatched in *May* were eleven days old before they fell into their firſt ſickneſs; thoſe hatched in *July* ten days, and thoſe hatched in *Auguſt* not quite nine: yet as he obſerves theſe times vary according to the weather and other circumſtances. Some *French* authors fix the ſeventh or eighth day for the firſt ſickneſs, in *France*, and I found it to be about the the ſame time in *England*.

That you may not be at a loſs for the time of their firſt ſickneſs, upon which the other three depend, I will be ſomewhat more particular concerning its approach, and concerning the appearances which the ſilkworm has during its firſt age; becauſe from its ſmallneſs, at this time, they might eſcape a common obſerver.

The ſilkworm when it comes out of the egg appears quite black, this in two or three days changes to a light mouſe colour: upon the approach of its firſt ſickneſs, the head begins to ſwell ſo as to be apparently

apparently larger than it was, in proportion to the body; it appears alſo more pointed towards the mouth than it did before, and upon their actually falling into the height of their ſickneſs they leave off eating, and remain quite motionleſs with there heads ſwelled, and raiſed, generally, above their bodies; and their colour is now a light yellowiſh brown, in which the rings of their body may be ſeen, if you view them cloſely.

They continue thus, without feeding, about three days; then the ſwelling of their heads begins to fall, and they caſt their old ſkins, which tho' on account of their ſmallneſs you may not readily obſerve, yet is as compleatly caſt now as at their laſt moulting, of which the magnifying glaſs will fully inform any one. You will know that they are quite recovered by the different appearance, which they immediately make after moulting, for they now appear of a very light grey colour about their necks, and the reſt of their bodies a dark grey; their heads are no longer ſwelled, nor their noſe ſharp; their bodies alſo appear ſlender, and not ſo ſtiff and ſhortened as when they lay

in their ſickneſs; and in half an hours time they fall eagerly on their food.

In the above deſcription obſerve, that the ſwelling of their heads is the obvious ſign of their approaching diſorder; their motionleſs ſituation with their heads erected ſhews their continuance in the height of it; and the light colour about their necks, their motion, and beginning to eat, ſhews their recovery.

Though they fall into their ſickneſs by ſome degrees, yet their recovery is almoſt inſtantaneous; for from the time that they begin to throw off their ſkins till it is quite off, is oft only about two or three minutes ſpace. They caſt it by fixing their tail to the leafy fibres, and then moving their body forward, after which they ſeem to reſt themſelves for a ſhort time, and then begin to eat.

Having fed about three days, they begin to fall into their ſecond ſickneſs with much the ſame appearances as the firſt, and laſting the ſame time, viz. three days, therefore it need not be particularly deſcribed; only obſerve that though they are ſaid to be well and feed three days, and to faſt and lie motionleſs for three days more, yet this

this is not to be taken ſtrictly, becauſe they eat a little even after they begin to ſicken, and therefore are ſomething longer in an eating condition, than in a faſting inactive one: you muſt make this ſame allowance for what ſhall be ſaid of their third and fourth ſickneſs; obſerve alſo that the warmer the climate is, ſo much the ſhorter is the time of their continuing ſick.

Having recovered from their ſecond ſickneſs, they continue in health for about three days, and then their heads ſwell as before, and they begin to fall into their third ſickneſs; their bodies grow ſomewhat gloſſy of a pale yellowiſh colour, and ſomewhat leſſened in length; they remain motionleſs with their heads rais'd, which now alſo appear ſharp toward the mouth, as in their former ſickneſſes. After three days, the ſwelling of the head falls, and ſometimes they ſuddenly grow as it were ſpeckl'd with dark ſtreaks, which colour proceeds from their old ſkin then beginning to ſeparate; they then continue ſtretched out at their length, for about two hours, after which they begin to ſtrip off their old ſkin from the head downward towards the tail, which is always the manner in which

it is done, and from the time in which they begin to ſtrip it till it is quite off, there is but about one minutes ſpace: they appear now of one uniform colour, which ſomewhat reſembles that which the ſmall ſmooth branches of an aſh-tree have: the new ſkin at firſt appears ſomething wrinkled, but as they begin to eat it ſtretches and grows ſmooth.

After their recovery from the third ſickneſs, they continue in health about three days, as before, and then their fourth ſickneſs begins with the ſame appearance as the third, and therefore need not be particularly deſcribed, being much of the ſame duration, and, as the worm is now grown large, eaſily obſerved; this is their laſt ſickneſs: after their recovery from it they appear of the ſame colour as after the third; two black comma's, in this ſituation (") appear on their back, a little below their firſt ring, which before this moult were not ſo manifeſt: after this they continue eating, and in perfect health for about ten days, that is till their time of being ready to ſpin.

I have in the foregoing account only mentioned the caſting off of their ſkins;

but I muſt inform you that they do at the ſame time, by rubbing their heads among the leafy fibres, caſt the entire ſcull including their teeth, and all other parts of it; and as their ſkin is ſtripped downward off their tail, ſo the ſkull comes forward off their mouth, and this is what gives their muzzle that ſharp appearance which it has during their ſickneſs, it being no more than the old ſcull ſticking to the point of the new one. When the worms are large you can eaſily with the naked eye perceive this caſting off their ſculls; and through the microſcope you may perfectly diſcover their jaws, teeth, &c. in it, together with ſeven moſt exceſſive ſmall holes, on each ſide near the mouth, which were thoſe of their eyes: for the two broad appearances on their head, which ſome miſtake for their two eyes, are only two bones of their ſcull: their eyes are ſeven, as I have ſaid, on each ſide, but ſo ſmall that when greatly magnified with a glaſs, they do not exceed a ſmall grain of ſand. The ſpots which, when the worms are grown, appear at regular diſtances down each ſide of the body, are alſo by ſome miſtaken for their eyes, but theſe ſpots are the breathing holes

through which the air enters into their lungs; and all the kinds of worms, and caterpillars which change into flies, do, in their principal organs and transformations, ſomewhat reſemble thoſe of the ſilkworm.

From what has been ſaid, it will eaſily appear that their ſickneſs is not ſleep, or a ſtate of reſt, though by ſome called ſo; but rather a fever, like that which accompanies the toothing of children, or the caſting of the feathers in birds, attended with a lethargick motionleſs ſtate, which indeed reſembles ſleep, and a total loſs of appetite, and abſtinence from food till they caſt their ſkins and the diſorder goes off.

The final cauſe of their thus caſting their ſkins, &c. ſeems to be, that their bodies may have room to grow and enlarge; their old ſkins, it is likely, growing too tough to admit of further extenſion, for which reaſon a new and tender one is neceſſary.

I hinted above, that though the duration of their ſickneſs, and of their ſubſequent health, is ſet down at three days each, from the beginning of their firſt moult to the end of their laſt, yet this ſhould not be taken in too ſtrict a ſenſe, ſince they eat a little

little ſometimes after their head begins to ſwell; and their ſtate of total inaction doth not come on immediately; ſo that they are perhaps a day longer in a ſtate of eating, than they are of abſolute faſting. So that you might reckon four days, in three of which they feed heartily, the fourth eat a little, and on the two next totally faſt.

Malpighius, who took his dates of their ſickneſs from the beginning of their totally inactive ſtate, divides the times of their health and ſickneſs in the following manner: after their being hatched, they continue in health for ten or eleven days, then they are ſick about a day and an half; their health after recovering laſts four days and an half; and their ſecond ſickneſs a day and half; their next health continues for three days; and their ſubſequent and third ſickneſs a day and half; the next health, which proceeds their laſt ſickneſs, he ſets down at four or five days continuance; the laſt ſickneſs at two days and an half; and their laſt healthy ſtate nine or ten days and then they begin to ſpin: but he obſerves that the weather, and other circumſtances make theſe times vary.

Notwithſtanding that the particulars which I have ſet down on this head, will inform you pretty well of the times of their ſickneſs, yet to be more perfect in it, you muſt add your own diligence of obſervation; and alſo conſider the climate and weather, which if it be cold or moiſt, generally retards and lengthens out the times of theſe changes and moultings in the ſilkworm; but your own experience, join'd to the tokens and marks which are given above, will enable you readily to know what ſtage of life, and what condition the worms are in, and alſo to know what will next happen, and conſequently what accommodation and management you are to prepare for them. Their times of moulting being, therefore, the principal thing which regulates many particulars in your attendance, and which when well known will eaſe you of much trouble, I need not inſiſt how much they are to be regarded.

The time preceeding each moulting of the ſilkworm may be called one age; ſo that to the fourth moulting there are four ages; and from the fourth to the time of its being ready to ſpin may be reckoned a fifth age. Each age is about five days long

long except the firſt, which is about ſeven, and the laſt which is about ten, in the climate of *England*; but in a warm ſeaſon, or in warmer climates. None of their ages are of ſo long duration.

The ſize of the ſilkworm when firſt hatched, and at its recovery from each moulting is ſhewn, Plate I. Fig. VI. the little curve line at top ſhews it juſt hatched. The numbers 1, 2, 3, 4, ſhews its ſize at the moultings which correſpond to them; the horizontal line being its length, and the perpendicular its diameter; and number 5, ſhews it a little before it is ready to ſpin; for, when quite ready, its ſize is ſomewhat leſſened.

CHAP. VIII.

Of feeding and managing the ſilkworms during their two firſt ages, or till they paſs their ſecond moulting.

THE ſilkworm's life, unto the time when it is ready to produce its ſilk, has been divided into five ages, reckoning one age at each recovery from moulting, and

and the fifth age from its fourth moult till it is ready to ſpin. The whole five ages together comprehend the ſpace of five or ſix weeks, more or leſs, according to the coldneſs or warmth of the climate.

The ſilkworms had juſt began the firſt of theſe ages, being newly hatched and diſtributed into their nurſery-drawers, when I left them in order to ſhew the method of getting food for them, and to give you a general deſcription of their four moultings; I now reſume the management of them at this firſt age.

They begin to eat as ſoon as they come out of the egg, and immediately fix themſelves on the mulberry leaves, which are thrown upon them; and from this time, until they become ready to ſpin, they continue almoſt conſtantly eating, except at night and during the time of their moultings. Now, as they are placed in drawers large enough to admit of their increaſe of ſize until they arrive at their firſt moult, you will have no occaſion to touch them nntil they have paſs'd it, and will have little more to do than to feed them regularly, by ſtrowing the tender ſliced leaves of the mulberry over them, and to give them

them a little air, or to keep them close and warm, according as the weather is hot and close, or cold and damp.

Some authors prescribe, that they should be fed only twice a day till after their first moult; but as the strowing of a few leaves over them is a matter of small trouble when they lie in so narrow a compass, I should rather choose to do it thrice or oftner in a day; for if you give them in the morning the quantity which is to serve them the whole day, you must lay them thick on the worms, and most of them would be withered, or unfit for food before night; and when you gave them fresh leaves, many of the worms would not come up to them, but would continue attached to those that happened to be a little fresh among the former old leaves, and thus you would, from time to time, bury and hide many of the worms among the fragments that remained, and it is by no means practicable, or worth the toil, to be searching and picking for them among the leaves.

But if you only strew sliced leaves thinly over them, so as that they shall just touch one another or thereabout, but not lie in heaps; or if you give only so many leaves

as

as you find by experience your worms can eat before they decay, excepting the groſſer parts and fibres, then at every new feeding your worms will quickly come upon the freſh leaves, and you will not then bury the worms underneath, neither will you make ſuch waſte of food, nor ſuch a great quantity of litter, or of moiſture and mouldineſs; and thus no more than ſome dry wither'd fibres will be left, which are of uſe and ſervice, as the dung of the worms will fall and be buried among them, and not at all taint the freſh leaves which you from time to time give the worms.

You ſhould therefore avoid giving too great a quantity of leaves at any age of the worms; for though when they are well grown, they will not be ſo eaſily buried, except at their moulting, yet by thus heaping, you will both waſte food and increaſe litter, mouldineſs and moiſture, and the labour of often being obliged to clean them. You ſhould rather defer giving them a freſh meal for ſome little time, than give them it before the former was eaten, if it remained freſh or fit for food; nay, if at any time you find the worms, while they are out of their moult and well, lazy to come

come on the freſh leaves which you give them, it is a ſign that they are too full, and you would not do amiſs if you let them faſt a little beyond the time in which you uſed to give them their next meal.

I have been thus particular, that you may avoid the great trouble which I have known to proceed from heaping too much food.

When you feed the worms, let the firſt feeding be as ſoon as you can conveniently in the morning; this muſt be done with the remainder of the leaves which were gathered the day before, and let the laſt feeding be as late as you can before you go to bed.

As the worms lie in the middle of the drawer, and at their firſt being placed there ſhould only take up about one third of it, you may enlarge the ſpace they lie on, at the time of feeding them, according as you perceive them to grow large and crowd one another; to effect this, you have no more to do than to place leaves round about, ſo as to touch thoſe the worms lie upon; and thus, as you ſee it neceſſary, you may extend their ſpace, for they will always follow and ſpread themſelves over the

the leaves which are contiguous to them; but if you ſpread the worms too much, they will not be able to eat all the leaves you throw over them, the inconveniency of which I have mentioned; therefore always keep them as throng as they can lie without being crouded upon one another.

While they are very young, you muſt, in cold weather, keep them cloſe and warm, ſhutting the drawers or boxes as ſoon as you have fed them, and expoſing them as little as poſſible to cold air; you may for this end keep a blanket or ſuch like over your whole cheſt of drawers.

But you muſt, on fine and warm days, uſe them to the open air, according to their age and vigour, pulling the drawers in which they are kept about quarter or half open in the middle of the day, and for as long as you ſhall judge convenient; and when you ſhut the drawers, turn that ſide which was out inmoſt, that when you air them next, the other ſide may have the benefit of it; for which reaſon the drawers ſhould be made to go in at either ſide. Scarce any general rule can be given for the time of thus airing them; the climate, weather, and other ſuch circum-

circumſtances muſt direct you. In temperate climates they ſhould be kept cloſe and warm till after their ſecond moulting; in hot climates too much heat and want of air will oftener hurt them than cold.

It would be of good ſervice, where great quantities of worms are kept, to have a thermometer; and having, by your experience, determined the greateſt degree of cold and the greateſt degree of heat which they could bear, without any manifeſt ſigns of harm, you might afterward, as the ſpirit in the thermometer varied above or below theſe points, regulate your conduct. You can give a good gueſs at their health by the vigour with which they eat, and their alacrity in coming on the freſh leaves which you give them, and hence you might pretty well aſcertain the degrees of warmth in which they thrive beſt. A like good uſe might be made of an hygrometer, which meaſures the moiſture and dryneſs of the air, and moiſture hurts them more than cold; but theſe are niceties which few can or will make uſe of. If the worms are near their moult, you muſt not then judge of their health by their liſtleſneſs and inactivity, for theſe are at that

time natural tokens of a natural and periodical diſorder, which though it is by ſome called a ſleep, yet is rather a ſort of lethargick fever.

In about five or ſix days after hatching, the worms will begin to fall into their firſt ſickneſs, which precedes their moulting. When therefore you perceive their heads to ſwell, and that they do not eat ſo heartily as before, give them their leaves more ſparingly, adjuſting the quantity of their food ſo as that it ſhall be eaten before next meal, and when you perceive them all to lie inactive, with their heads erected, and that they no longer attempt to eat, you ſhould then deſiſt from giving them any more leaves, and by no means diſturb or move them either now or in any of their moults, but let them lie quiet and warm, by ſhutting the drawers or boxes where they lie, eſpecially if the weather is cold, during their two firſt moults.

You will often perceive ſome worms grow ſick a little before the reſt, though they were all hatched together, on account of ſome inequality in their ſtrength or conſtitution; or becauſe, though they were all taken out of the hatching boxes together,

ther, ſome came out of the egg perhaps three or four hours before the reſt; theſe early ones will be a ſort of notice to you to moderate their food, for that the others will ſoon be in the ſame ſtate.

If by any miſmanagement worms of different ages were mixed together, you may now ſeparate them from one another; if, for inſtance, a great number of your worms which are in the ſame drawer abſtained from their food, and grew motionleſs in the morning, and the reſt continued eating till late at evening, then by giving a few freſh leaves theſe will come upon them, and ſo may be taken away from the reſt with thoſe leaves on which they have fixed. But as the picking the leaves up in order to remove them is tedious, and alſo unleſs great care is uſed may cruſh many of the worms, whether by taking hold of the leaves with your fingers or with plyers; therefore I think it a better way to ſeparate them now by the means of papers with holes cut in them, in the manner directed for taking away the worms out of the hatching boxes.

But if all your worms fell ſick together, you would now have nothing more to do

than to wait for their recovery, and would not have the trouble either of ſeparating thoſe of different ages, nor of feeding ſome which were of a different age in ſeparate drawers. And this you might effect, by getting all your eggs to hatch at once, which therefore you ſhould, as much as you can, ſtrive to do. It is true indeed, that though all your worms had been taken out of the hatching boxes at one time, there might be ſome which would ſicken a little ſooner than the reſt from different ſtrength of conſtitution, and conſequently recover and begin to eat ſooner; and if the difference of time were about twelve hours, and that there were a ſufficient quantity of ſuch worms to deſerve a diſtinct place, it would be beſt to ſeparate them; but then this may be done after their moult, by giving them a few leaves when they recover before the reſt, and then taking thoſe leaves with the worms on them, and placing them by themſelves in a diſtinct drawer. But if you have large quantities of worms hatch'd at different times, and that almoſt all your firſt hatched ſickeneth at once, then you may take away thoſe few that are later than the reſt and put them among your ſecond hatching,

hatching, and the few that ſhall happen to be tardy among the ſecond hatching transfer to the third, and ſo on. Yet if there is but little diſtance, for inſtance, only half a day, or even almoſt a whole day, between the ſickening of thoſe which lie in the ſame drawer, you may defer ſeparating them till their ſecond moult, or till their third, if the difference of time is too little at their ſecond; the difference generally increaſing at each moult.

You muſt however take care to feed thoſe which are in a feeding ſtate among the ſick ones, if you do not ſeparate them, but do it very ſparingly, ſprinkling the leaves very thin, that you may not bury the ſick worms. Moſt of what I have been ſaying tends to one principal end, viz. that of keping the worms of different ages diſtinct from one another, and whichſoever of the methods you chooſe, you will be ſenſible that it is an uſeful and neceſſary thing.

You will not be at any loſs to know when your worms have moulted and recovered from their firſt ſickneſs, the appearance they then make being very different from that which they had during their diſorder, according to the marks given in

the chapter on moulting. And now, as they recover, give them their leaves gathered as neat and clean as poſſible, and if they lie too throng, ſeparate and diſtribute them into other drawers as they come upon the freſh leaves. You may either diſtribute them in ſmall parcels at ſome little diſtance in the drawer, ſo that they ſhall ſpread and meet as they grow large, or you may place them all in the middle of a drawer, and let them extend and ſpread all round, by laying leaves round them when they begin to lie too throng.

Your worms are now in their ſecond age, and enlarged in ſize; and the leaves which are to feed them are alſo grown firmer; with theſe you muſt continue to nouriſh them: and the rules which have been already delivered for their firſt age being, with your own diſcretion, ſufficient for this, their appearance alſo and time of moulting being much the ſame, excepting their ſize, I ſhall only refer you to what has been already taught, to avoid the tedioufneſs of repetition. After about three days health and three days ſickneſs, you will find them recovered from their ſecond moult, in which ſtate I ſhall take them up

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in the enſuing chapter. Obſerve here however, that a worm juſt recovered from any moult is not larger, but rather leſs, than one which is going to fall into the ſame moult, leſt you ſhould miſtake their age on account of their ſize, which ſize only advances during their health between each moulting. Take notice alſo, that the drawers and warm-keeping here mentioned are only for climates where the ſpring is cold at the time of hatching ſilkworms, and are not neceſſary in the warmer latitudes.

What I have ſaid in this chapter is ſufficient for the management of the worms during their two firſt ages; I have made no mention of cleaning away their litter, or the broken fibres of their leaves, for at this time it is unneceſſary; the litter they now make is ſoon as dry as duſt, and the fibres of the leaves are alſo ſoon withered, and make a ſoft bed, on which the worms lie cleaner than if they were placed on paper, for the litter runs down among the fibres, and ſo doth not at all incommode them, eſpecially if they lie on a hurdle made of ſtraw, reeds, or ſuch like, through which the litter can paſs. I have known

ſome of our ladies who kept ſilkworms give themſelves an endleſs trouble in cleaning and picking them from the old leaves and fibres every day, a thing which cannot be done without injuring the worms, and for which there had been no neceſſity, had not their food been crouded faſter than they could eat it, and the leaves given without ſlicing them, which would have hindered them to curl and invelope the worms.

I have read, that in *Spain* they keep the very young worms in flat ſtraw baſkets ſmeared on the inſide with cow's dung, and then dried, and that they reckon the ſmell of the dried cow-dung wholeſome for the worms.

CHAP.

CHAP. IX.

How to manage the Silkworms during their two next ages, that is, from their recovery out of their ſecond moult to their recovery out of their fourth.

WHEN the ſilkworms are recovered from their ſecond ſickneſs, they will be able to bear the air on open ſhelves if the weather is fine, and you had accuſtomed them to the freſh air at times before, when you found the day warm, to inure them to it. You may therefore now place them upon ſome of your ſhelves made of hurdles, in the large ſtands, and as there has been no occaſion as yet to take away their litter, if it remain'd dry and they were properly managed, ſo neither is there any now; it is no more than a looſe cake of dry fibres connected partly by its own materials, and partly by a fine cobweb which the worm is almoſt conſtantly ſpinning from its birth; the little dung, which lies among the fibres of this cake, is alſo quite dry, and in this caſe I never found a worſe

worſe ſmell proceed from it than that of dry graſs or hay, but indeed if it had contracted much mouldineſs and moiſture for want of air, or by heaping too much food, it would be otherwiſe, and have an offenſive ſmell.

You might have inured the worms to the open air, by laying the drawers, or whatever elſe they were nurſed in, upon the hurdles in the day time, and returning them back into the cheſt of drawers at night, and afterwards, if the weather is warm, by letting them lie all night on the open ſtands in the ſame drawers.

When you intend to ſhift them out of their drawers to the hurdles which compoſe the ſhelves of your large ſtands, you need only raiſe the whole cake of fibres with the worms on it, and lay it on the middle of the hurdle, or raiſe one edge of the cake over the edge of the drawer upon the hurdle, and then gently ſhift the drawer from under it; this would be the eaſier done if one of the ledges of the drawers had been contrived to ſlip of.

As the worms will as yet take up but few of your ſhelves, you ſhould place them on thoſe ſhelves where they will be eaſieſt

fed;

fed; that is about three foot high, and always obſerve to keep the high and moſt troubleſome ſhelves empty of worms as long as you can.

When the worms lie thus on the cake of fibres in the middle of the ſhelf, you are ſenſible that as they grow and ſpread on the hurdle, thoſe on the edge of the cake will have ſcarce any thing under them but the reeds or twigs of which the hurdle is compoſed; if therefore you think this keeps them as yet too cold, or that your hurdle is ſo wide that they drop through, or any other inconvenience attends this, you may remedy it by laying ſheets of coarſe paper, but free from every thing offenſive to the worms, round the edge of the cake of fibres, and as the cake extends with the growth of the worms, by the ſame degree you may draw out the papers, ſtill leaving ſome under the edge of the cake, till you find no inconvenience follow from taking them quite away. A little fine hay, ſpread thin over the empty part of the hurdle round the cake of fibres on which your worms lie, might anſwer the ſame end.

On theſe ſhelves continue to feed your worms thrice a day; do not be at the trouble of laying the leaves over them one by one, but, taking them by handfuls, ſcatter them at firſt thinly over your worms, not letting them fall in heaps; it is beſt to ſcatter them firſt where the worms lie thinneſt, which will draw them from lying in crowds, and afterwards you may throw them over thoſe places which remained unſupplied.

As the worms are now to continue on theſe ſhelves, you muſt, if the weather ſhould change to cold, keep the doors and windows very cloſe, and you may further guard againſt the cold, by throwing a covering of thin light paper over them, ſo long as the bad weather continues; and theſe remedies will have the better effect, if, while the weather was warm and fine, you had not kept them too tenderly, but had given them the freſh air now and then, eſpecially in the heat of the day; an equal temperature of heat being what agrees beſt with them, and to this your conduct and contrivance muſt come, as nigh as you can bring it.

Now after the third day from their recovery out of their ſecond ſickneſs, your worms will begin to fall into their third; their heads will ſwell, their bodies look ſmooth and gloſſy, and ſomewhat ſhorter, and they will, after ſome time, deſiſt from eating, remaining motionleſs, with their heads generally raiſed, as in the former moultings.

Thoſe which continue feeding ſix or ſeven hours after the others have done, may now be removed, taking up the leaves on which they are, and claſſing them with thoſe of the ſame time of moulting, or you may wait till they begin to grow well, and then ſeparate thoſe that firſt recover from their moult. Their moult ends in about three days as before, but their appearance juſt before they moult is ſomewhat different from the two former moults; for having been during their ſickneſs of one uniform light colour, they now, about an hour or two before their recovery, turn dark and ſpeckled; they then lie inactive for about an hour or two, the ſwelling of their head falls, and they ſtrip off their ſkins from the head downward, and caſt their ſculls forward off their noſe like a maſk

maſk taken from the face, as you may now obſerve with the naked eye; their colour alſo after this moult is different from what it was after the two foregoing ones, having no more that light grey on the neck, or that darker greyiſh colour which they had on the reſt of their body, but being of one uniform hue, like the ſmooth bark of an aſh branch, but a little more inclined to a red colour.

Your worms being recovered from this third moult will be pretty large, and ſome of them ſhould be diſtributed on other ſhelves to make room for their further growth, which will be pretty conſiderable before their next ſickneſs. You may diſtribute them on the other ſhelves or hurdles, by taking up the freſh leaves with the worms on them in what quantity you find convenient to take away; but it would perhaps be beſt to take them entirely from one ſide of the hurdle, and not pick them up here and there, for this might leave thoſe that remained ſo ſcattered as not eaſily to be fed, and I mentioned elſewhere that they ſhould always be kept as cloſe as they can, without crouding on one another.

Or

Or you may distribute them on other shelves, taking what portion you think proper of the cake of fibres whereon they lie, by putting your hands under it and gently separating it from the rest, and then laying it where you intended, repeating the same method if you had not taken enough at first.

And if at any time you find this cake of litter moist, mouldy, or fœtid, your worms should all be taken from it when they come upon the fresh leaves, and all the cake of litter should be thrown away, or at least you should separate the upper layer of fibres whereon the worms lie from the under part; which you may pretty easily do, as the cake is generally composed of many layers of fibres, by raising the layer at first on the edge with your hand, and still as you raise it, sliding a thin board under it; the board should have a short handle like a wool-card, and when you have as much of the cake as it will take of, separate it from the rest, and gently slide it on the shelf you designed it for, and so proceed to take more. A little shovel or board of the above kind, with a small ledge on all sides, except the forepart, may be found at other times

times convenient for carrying parcels of worms from one ſhelf to another.

When your worms after this third moult are diſtributed conveniently, continue to give them leaves thrice a day, in ſuch quantity as they can conſume between each feeding, and according to thoſe general rules given concerning the quality of their leaves.

As the worms may now take up ſo much room that ſome muſt be placed on hurdles under others, you muſt guard that their dung falling through may not incommode the under ſhelves; coarſe paper, thin matts made of baſs, or other ſuch like cheap materials may be placed under them on the hurdle to prevent this; or rather, fix theſe matts, ſo as that one ſide of the matt being faſtened to the bar of the ſtand which goeth acroſs, the other oppoſite ſide of the mat having a rod faſtened to its edge, (as large maps are ſometimes framed) may hang with a ſlope, the rod bearing on the outſide of the uprights which form the ſtand. If theſe are thought too troubleſome, the hurdles ſhould have been woven ſo cloſe as not to let the litter paſs through; or at leaſt you ſhould take out the hurdle

when you go to clean it; but if the hurdles were made ſo cloſe as to hinder their litter from falling through, there would be no occaſion for any thing under them.

After about three days feeding of the worms, which muſt be managed much the ſame way as in their foregoing age, they will begin to fall into their fourth and laſt moult, which having the ſame appearances as the former need not be inſiſted on. In three days they recover from it, being of a colour the ſame as after their former moult, but their foreheads broader and their feet larger and furniſhed with claws; their tails alſo broad, and furniſhed with an infinite number of fine hooks, with which they are enabled to cling and ſupport their weight.

N. B. If each receiver has two rods a little longer than its edge, one rod may lie over the pins which ſupport the hurdle above it, inſtead of making croſs bars, as mentioned in the laſt paragraph but one. See Plate I. Fig. 1.

CHAP. X.

The management of the Silkworms during their fifth age, that is from their recovery out of their fourth moult, till they are ready to ſpin their ſilk.

IF you did not diſtribute the worms upon other ſhelves on their falling into their fourth ſickneſs, it muſt be done now upon their recovery from it, by ſome of the methods given in the laſt chapter; and though they be kept on the wide-woven hurdles, yet they need have nothing under them, unleſs it were ſome looſe ſtraw or ſuch like, that the air may have the better acceſs both to dry the fibres which the leaves make, and to keep the worms cool and refreſh'd; for too much heat or any moiſture would at this age very much hurt them.

The ſloping receivers of coarſe paper, baſs-matting, or ſuch like, will hinder their dung from dropping through one hurdle upon another, if they are ſuch hurdles as were woven wide for this purpoſe; and this litter may eaſily with a feather or light bruſh

bruſh be ſwept off theſe receivers when there is occaſion; but theſe are unneceſſary with cloſe hurdles.

It is in this laſt age that you will moſt find the benefit of keeping the worms on hurdles; for as they will now eat during nine or ten days before they are ready to ſpin, and will grow very large, making a prodigious deal of litter; they would, if they were kept upon ſhelves made of boards, require to be cleaned every day, which cannot be done without removing them every time you clean them: but on hurdles made of ſmall reeds, which are very dry and light materials, and have vancancies between them, the air will have acceſs to that litter which ſticks and remains among the fibres and ſhreds of their leaves, and it will not ſo ſuddenly grow putrid, moiſt, and mouldy, as it would do if the whole quantity of litter and fibres lay on boards or ſhelves, which did not admit the air underneath.

It will, however, often happen that pretty large ſhreds of leaves which are not eaten, ſhall ſo clog and fence up the interſtices of the hurdle, as to hinder the air from paſſing through, and will nake it neceſ-

ſary to clean them in ſome manner or other: to do this I would propoſe the following method, when the hurdle is made ſo as to let the litter paſs through. Raiſe the hurdle on one ſide ſo as to ſtand aſlope as much as the next upper ſhelf will let it, and fix it in this ſituation ſecure from dropping down; then take a ſmall fork made with two or three wide teeth of pretty ſtrong wire, and a little hook'd at the points, and thruſting it underneath between the interſtices of the hurdle, ſo as to take hold of the under fibres, draw them down, and thus going over the bottom of each hurdle, moſt of the litter which before ſtuck will run down on the receiver.

The fork ſhould not be very ſharp, but have round blunt points; and, if the fibres are not very thick, take care of hurting the worms as you pull them down: it will alſo promote the falling down of their dirt, if either before or after this, you do with a copper or braſs bodkin or ſuch like inſtrument, a little raiſe the fibres on which the worms lie, ſo as to make them lie looſe, which will diſengage the dirt from them, and will alſo make the worms eat thoſe parts of their leaves which remain freſh;

freſh; but which, by lying flat under the worms, would not otherwiſe be eaten: it would be beſt therefore to do this before you give them a freſh feeding, if much of their former leaves remained unconſumed.

If your worms lie on ſhelves of boards, or in any other way that their litter cannot fall through, and, that it is neceſſary to clean away all their litter from under them, you may do it by removing the worms when they come upon the freſh leaves to one ſide of the ſhelf which is empty, and then making clean the part from which they were taken, remove the next neareſt worms upon this, and ſo on until you have clean'd them all; and you need not at this age of the worms be afraid of taking them up with your hands, provided they are clean. But in removing the worms thus with your hands, do not by any means pull away thoſe fibres which ſhall cling to their claws, but lay them along with them: the tearing and forcing them from theſe fibres, I take to be a great cauſe why many of them do not care for mounting the branches where they are afterwards to ſpin; their claws being ſo blunted and ſtrained, that they

cannot lay hold of the twigs and climb, without being ſubject to fall and tumble down, which ſo fatigues them that they give over the attempt.

The worms at this fifth age will eat a prodigious quantity of leaves, which ſhould now be of the beſt ſort you can procure for them, becauſe it is now that they collect and digeſt the matter out of which they afterwards form their ſilk: if you were to open a worm before the fourth moult, you would find nothing but a watery humour mixed with the green mucilage of the leaves which they feed on; but when they are ſomewhat advanced in this laſt age, you will find in their ſilk-veſſels a pale or yellow gum, out of which they form their balls of ſilk.

The goodneſs, therefore, of their ſilk depending, in a great meaſure, upon their being properly fed at this time; you muſt take care that their food may be, in all reſpects, as good as can be got; not the ſoft tender leaves of ſuckers, or of trees growing in moiſt watery places, or of thoſe which are very young, but the firmeſt dark green leaves from your oldeſt trees; and theſe always free from dew or moiſture,

ture, which would now make the worms dropſical and burſt them.

They muſt in the beginning of this age be fed four or five times a day, viz. very early in the morning; about ten of the clock; about three in the afternoon; about ſun-ſet; and at night juſt before you go to bed. Your gatherers ſhould therefore be abroad as ſoon as the dew is off the leaves, that they may ſupply you at ten of the clock; or, if they have far to go, and cannot return ſo ſoon, you muſt always preſerve two feedings out of the former day's leaves.

During the ten days in which the worms are now to be fed, before they are ready to ſpin, you muſt increaſe the quantity of leaves which are gathered every day; for the worms every day will eat more than on the former; and when they are within a few days of ſpining, you muſt not confine them to four feedings, but muſt take care that they get them as often as they want, remembering always to feed them late at night before you go to bed, and as early as you can in the morning.

In this laſt age alſo you muſt give them air, by opening the windows for three or

four hours during the heat of every fair day; and even though the weather is foul, yet, if you perceive the place where they are kept to ſmell ſtrong upon your coming into it, you muſt, notwithſtanding this, open the windows for a ſhort time to refreſh the air; and you ſhould afterwards examine whether their litter is not gathered too thick, and clear it away. Nor ſhould you now keep the worms too throng, but as airy, clean, and neat as you can conveniently.

Notwithſtanding the many rules and inſtructions which have been given, chiefly that you might not be at a loſs in any circumſtance, yet before their fourth moult, you will not find much trouble in managing the worms; but in this laſt age your labour of feeding, and attending will be conſiderably increaſed; yet as it laſts but about ten days, and as the advantage which you are to reap from the ſilkworms depends much on your diligence at this period; you muſt ſubject yourſelf without reſerve to it, or loſe the profit which you expected.

The worms being fed plentifully as already mentioned, will, within ten days after

ter their recovery from their fourth moult, have arrived to their utmoſt growth, being two inches and an half long, and an inch and quarter round, nearly; their colour light, but not gloſſy, with ſome mixture of a dark greeniſh hue: but in a days time, having prepared and digeſted the materials of their ſilk, they will loſe this greeniſh colour, their bodies will get an ivory colour and poliſh, toward their necks ſomewhat tranſparent, with a little of a faint orange colour. They will leave off eating, and before they are ready to ſpin, they will ſomewhat leſſen in ſize; but their bodies will feel more firm and conſiſtent than they did before.

They will now totally deſiſt from eating, and begin to wander about, ſtretching out their heads in queſt of a place proper to fix in and ſpin their ſilk-balls. Now though, on account of preſerving ſome little order and method, the inſtructions for accomodating them, at their ſpining time, are not given till the beginning of the next part of this treatiſe; yet it is proper that you ſhould have look'd forward into that part, in order to have made the neceſſary

neceſſary preparations for them ſometime before-hand; for you would find yourſelf greatly embaraſſed to do it when numbers of the worms were to be accommodated if you had not made ſome proviſion before.

It may be proper, before I end this chapter, to inform you that the worms which are hatched from ſix ounces of eggs, require the attendance of two perſons till they have paſſed their fourth moult, after which they require five or ſix. They will produce from fifty to ſixty pounds of ſilk, and in a favourable ſeaſon a good deal more.

THE
Culture of SILK.

PART III.

CHAP. I.

The method of accommodating the Silkworms with branches proper to ſpin their ſilk in.

I Have now brought the ſilkworms to that period of their lives, at which your labour of feeding them ends; for from the time that they are quite ready to ſpin, they no more take any kind of food, though their life in different forms laſt above a month longer, and, in cold climates, a good deal more. Yet, though you will be eaſed of the trouble of feeding thoſe which are come to their ſpinning time, you will for a few days, till they are all ſettled in their work, be obliged to give them a diligent attendance.

In

In order to dreſs the ſhelves for your worms to ſpin their ſilk, you ſhould have prepared before hand good quantities of broom, heath, pruning of vines or ſuch like materials, of which broom is the beſt, which ſhould be very well dryed, in the ſun, ſometime before you uſe them, and ſhould be free from leaves, and all dirt, moiſture, mouldineſs, or offenſive ſmell; theſe branches ſhould be laid in bundles like a whiſk or beſom, their ſmall tops placed as equal together as you can, and then you ſhould with a bill-hook cut off their thick ends, ſo as to leave them half a foot longer than the diſtance between each ſhelf, that, when the thick ends are ſet on the ſhelf, the ſmall twigs being bended, may bear againſt the bottom of the ſhelf which is above it. With theſe twigs you are to form ſeveral long arbours, arched at top, quite acroſs each ſhelf; the diſtance between the ſides of theſe arbours, ſhould leave the arch open quite through, about a foot wide, that there may be room to put in your arm, and feed thoſe worms which are not yet quite ready to ſpin.

You muſt form theſe arbours by the following method: firſt place one row of twigs

twigs within two or three inches of the edge of your ſhelf, bending their tops inward, ſo as to bear on the ſhelf above; then place another row of twigs, at about a foot diſtance, with their tops bending ſo as to meet and form an arch with the firſt row. The third row of twigs, which is to form one ſide of the next arch, muſt be placed within two or three inches of your ſecond row, with the tops bended the contrary way; and the fourth row, which compleats this ſecond arbour, at about a foot diſtance, with the tops bended ſo as to meet and arch with the third row; and thus proceed till you have formed as many of theſe arbours as the ſhelf will contain, which will not be above two, in a ſhelf of three foot ſquare, or three on a ſhelf of four foot ſquare; becauſe the buſhy partitions between the arches, and alſo thoſe of the outer ſides, will each be four or five inches in thickneſs. You muſt ſhift the worms aſide to make vacant lanes where each partition ranges.

You ſhould form theſe arbours ſo as to have a ſort of buſhy appearance without being too thick or too thin, but ſo that the worms may have room enough to ſpin, and yet the vacuities among the twigs not be

be ſo large as that they ſhall waſte a great deal of their ſilk, before they can fix on a proper place; the ſize of their balls, which is that of a pigeon's egg, will direct you in this matter; and the better to accompliſh this end, you may leave the vacant ſpaces, among the partitions of the arbours, pretty large and open, till you have done forming the arbours; and then you may thicken them properly by placing in theſe vacancies, either ſmall twigs, or ſome kinds of large hollow tubes, ſuch as thoſe of full grown angelica, and others which have no bad qualities. You ſhould gather theſe tubes the year before, when they are white and withered, and if you ſlit them lengthwiſe from end to end, they will make a very good conveniency for the worms to form their balls in, being very light and dry, and ſoft, and ſmooth on the inſide, and of ſuch a form that the worm will immediately fall to work in them, and make very little floſs or uſeleſs ſilk; and if you bundle, and lay them by when you have done with them, they may ſerve you many times over; you may thruſt theſe, along the vacancies, into the partitions of your arbour, among the twigs and branches, and you will

will find the advantage of them; ſince, as I mentioned before, the more any place is adapted to the ſize and figure of the ſilk-ball, the leſs ſilk will be waſted in floſs and uſeleſs web; beſides that the worms will more quickly ſet about, and finiſh their balls.

With theſe therefore, or any branchy materials, you may fill up the partitions of your arbours; obſerving ſtill to leave the arches clear and open, ſo that you may readily thruſt in your arm, and feed your worms that are plac'd under them, which muſt be ſupplied with leaves, moderately, till they climb up among the branches to ſpin.

I have ſaid that, whatever materials you make uſe of, in forming theſe arbours, they ſhould be very dry, and clean; for freſh branches with the ſap in them are not proper, nor ſhould there be any leaves on them, for theſe would ſo ſtick among the floſs ſilk of the balls as to render it uſeleſs; it is beſt therefore to cut the branches of broom in winter, and have them dry'd againſt ſummer, for broom, on account of its pliableneſs, is very convenient for forming theſe arbours, the ſtructure of which I have

I have given from *Iſnard* a *French* author who treats the management of ſilkworms.

If the making of ſuch arbours as thoſe I have mentioned be thought too nice, and troubleſome, it may ſufficiently anſwer the ſame purpoſe, to place branches of broom round the ſides of the ſtands. And to do this; firſt ſurround the ſtand with a cord tied very looſely to the uprights, ſo as to leave room to thruſt in a ſufficient quantity of branches; the branches now may be as long as the height of the ſtands, and their thick ends, being thruſt down between the cords and the ſtands, may reſt upon the floor; and thus you may thicken them to what degree you pleaſe; but you muſt remember to keep an open on one ſide of the ſtands, to feed thoſe worms which ſhall not yet have climb'd the branches; and becauſe the lower ends of the branches are not ſo buſhy as the upper ends, you may place ſome with the buſhy part up, and others down, to make it all alike branchy.

If the branches are not tall enough to reach as high as you have worms on the ſtands, you muſt place other branches reſting on theſe where they end, and ſupport-

ed

ed by other cords; and thus you may quickly furniſh your worms with a convenient place for ſpinning their ſilk.

If the hurdles are very broad, you may, when the worms are near ſpinning, draw them towards the ſides where the branches are, by ſcattering the leaves toward the branches when you feed them; or you may, if neceſſary, place them near them with your hands; or, which is eaſier, you may make buſhy partitions acroſs the end of each hurdle by branches laid horizontally.

Du Halde, in his hiſtory of *China*, ſays they there make uſe of matts for their ſilkworms to ſpin on; in the middle of this a thin ſtrip of about an inch broad is fixed on its edge, and forms ſpiral rounds, at about an inch diſtant, over the whole ſurface of the matt; and between theſe rounds the worms ſpin. There would be leſs floſs made in this method, but then the breadth of mattings muſt exceed the breadth of all the hurdles whereon the worms were fed, becauſe a ſilk-pod takes up much more room than a ſilkworm.

It would be endleſs to recite all the methods which might be contrived for this

purpoſe, for a ſilkworm will ſpin in any corner where it can ſtretch its threads, ſo it is able afterwards to form its oval pod upon them; that contrivance which, with little trouble, will have the leaſt floſs produced, would be the beſt.

Note, that in placing the broom round the ſtands, it may be uſeful to place ſome branches acroſs, mixing them with thoſe which ſtand upright, to give them ſome ſtiffneſs; otherwiſe the ſpring of the thread which the worm ſpins may, after it has begun its ball or pod, draw the twiggs too cloſe, and not leave it ſpace enough to ſpin in, which I have ſometimes ſeen happen among ſome of the ſmall detached twigs, that were not made firm by others mixing with them.

Plate I. Fig. I. in the middle diviſion of the ſtand at G. is ſhewn the manner in which the arched arbours are to be formed on each hurdle for the worms to ſpin in, according to *Iſnard*'s method.

In the other diviſion at C I. is ſhewn a part of the ſtand ſurrounded with branches, according to the other method. The whole ſtand is to be ſurrounded in the ſame manner, leaving only an open in front at each diviſion

diviſion to feed the worms. Branches may alſo in this method be ſuperadded to thoſe which ſurround, by laying them acroſs the hurdles on the ſides which are quitted by the worms.

CHAP. II.

The management of the Silkworms during the time of their ſpinning.

WHILE the ſilkworms are ſearching for places to ſpin their pods, ſome of them will often wander about the middle of the hurdles, waſting their ſilk in uſeleſs floſs. Indeed, if the ſtands are furniſhed with arched arbours, as deſcribed in the firſt part of the foregoing chapter; or if there is a buſhy partition made acroſs the hurdles, which have the broom only placed round them; in either of theſe caſes the ſilkworms will ſcarce miſs of a place where they may readily ſpin their pods; but in large hurdles, that have the twigs only placed round them, you muſt often look, and whatever worms you find wandering under the hurdle, or far from the

arbours, you muſt take and place near the twigs, provided they are ready to ſpin, and their wandering from their food is a ſign that they are ready; you need not fear hurting them by taking them in your hands, only let theſe be clean, eſpecially from tobacco, onions, and ſuch like; and you may take as many at once as can lie in your hollow'd hand without ſqueezing; but obſerve to take them up with whatever ſticks to their claws, without tearing it away, for fear of blunting the claws by which they are now to climb. Wooden ſhovels, which have a ſmooth ſurface, on which they cannot lay hold with their claws, are the fitteſt to convey them from one place to another, becauſe they can readily be taken off them without uſing force.

As a great many of the worms will continue to eat for ſome time after others have begun to ſpin, you muſt conſtantly ſupply them with the beſt kind of leaves, ſprinkling them very thin over them, and feeding them often, and this even at night juſt before you go to bed, and as early as you can in the morning; for their quantity of ſilk, and their ſtrength and activity in ſpinning it, depends now upon their being properly

properly and fully ſupplied as long as they continue to eat; for which reaſon, you muſt give them their leaves often, though but few at a time, becauſe if they lie under the arbours it is not eaſy to clear away their litter, which yet however muſt be done, if it grows throng and ſmells much.

If you find that as many worms have got among the branches as can conveniently ſpin there, then take away thoſe which have not yet mounted, and place them upon another ſtand, among worms which will ſpin nearly at the ſame time; for if the worms are too much crouded in the arbours, they will be more apt to ſpin double balls, which having two worms in one pod, cannot be reeled off; and therefore, as you look over the arbours, whereever you ſee two worms begin one common pod, you ſhould take one of them away, and place it in ſome other part of the twigs.

A little before the worms on any of the ſtands were ready to ſpin, you ſhould have clean'd away their litter from all the hurdles, that the ſtands may be ſweet and airy at the time of ſpinning, and that you may not at that time diſturb or ſhake the

arbours where they are ſpinning; for this would ſtop and interrupt their work, ſo that ſome would deſiſt from making any more ſilk, and the pods of others would be ill-formed, and difficult to reel off; for which reaſon you muſt always take care, in whatever way you are employed about thoſe worms which are ſpinning, to ſhake or moleſt them as little as you can.

As you were directed, in feeding the worms, to keep thoſe which were of the ſame age on the ſame hurdle, ſo you ſhould alſo, in diſtributing them as they grow large, always have kept them on the ſame ſtand, that they may ſpin at the ſame time, ſuppoſing that you have many ſtands of hurdles.

When moſt of the worms that lie on any hurdles have climbed the branches in order to ſpin their pods, you will generally have ſome on each hurdle, which, though they are ready for ſpinning, yet are either too lazy, or too infirm to climb the branches, and remain below, waſting their ſilk among the ſhreds of leaves; theſe ſhould be collected from all the ſeveral hurdles where they lie, and ſhould be placed on beds of branches ſtrowed pretty thick on ſome ſpare ſhelf, or other convenient

nient place, which branches may be mixed with the ſhavings of deal boards, peelings of oſiers got from places where baſkets are made, and ſuch like materials, being well dried. Among theſe ſuch worms will ſpin, unleſs they are much ſpent and grown very ſhort; in which caſe you may place them in paper cones, or ſuch hollow tubes as I mentioned above, where, if they have any ability left, they will not fail to ſpin; their balls however will be but ſmall and imperfect, and none ſuch as theſe ſhould ever be ſaved for breed. A warm place helps the ſpinning of weak worms.

It is uſeful to viſit all the arbours from time to time, and to replace ſuch worms as may have tumbled down, and ſuch as have ſtrayed into places where they cannot fix their balls; or rather you ſhould put them upon ſuch beds of branches as have been juſt now mentioned, if they are late ſpinners.

If the worms, at the time of their going to ſpin, do ſeem in general lazy or ſickly, to perfume their room with thyme, lavender, and ſuch like ſweet aromatick herbs, is good for them; it may be done, by putting the herbs on an earthen plate over a

chaffing-diſh of clear charcoal, and ſhifting it to different parts of the chamber. The fume of vinegar is alſo ſaid to be good for them, and theſe things are alſo directed at other times when they are ſick, but if they are well they will rather hurt them.

Cold and damp weather during the time of their ſpinning is extremely hurtful; in very cold weather the worms deſiſt from their work; you may ſee them, while their balls are yet thin, either moving very ſlow, or quite inactive; if you remove one of the balls to a warm place, the worm immediately begins to work with activity, and deſiſts again when put in the cold, where, if it continues, the worm at length totally leaves off its ſpinning, and is changed into a *grub* or *chryſalis*, which is its ſtate in the ball before it becomes a moth. This interruption of its work, though it ſhould continue to ſpin, makes the ball difficult to wind off, the thread often breaking; wherefore, if this kind of weather ſhould happen, you muſt keep the room cloſe and warm, uſing perfumes and fires of clear charcoal on iron chaffing-diſhes as above, and it is adviſed by ſome to put a piece of iron among the coals, to keep

keep down the ſulphurous vapour of them. If the fume of the coals ſhould become very ſenſible, it were beſt to admit the freſh air for a little while.

This inconvenience of cold and moiſture will happen chiefly in cold and changeable climates; but in hot climates you will oftener have occaſion to guard againſt ſultry and ſuffocating heats, which can eaſily be done by admitting the freſh air. An eaſy method of introducing either freſh air, or aromatick vapours into the room where you keep the ſilkworms, may be ſeen in the chapter on the diſeaſes of ſilkworms.

CHAP. III.

The manner of the Silkworm's ſpinning its ſilk-pod or ball; its continuance in it, and the changes it ſuffers while it remains there, till it comes forth in form of a moth or butterfly.

THERE is ſcarce any thing, among the various wonders which the animal creation affords, more admirable than the variety of changes which the ſilkworm

undergoes; but the curious texture of that ſilken covering with which it ſurrounds itſelf when it becomes a moth, and arrives at the perfection of its animal life, vaſtly ſurpaſſes what is made by other animals of this claſs. All the caterpillar kind do indeed undergo changes like thoſe of the ſilkworm, and the beauty of many of them in their butterfly ſtate greatly exceeds it; but the covering which they put on before this change into a fly is poor and mean, when compared to that golden tiſſue in which the ſilkworm wraps itſelf. They indeed come forth in variety of colours, their wings bedropp'd with gold and ſcarlet, yet are they but the beings of a ſummer's day, both their life and beauty quickly vaniſh, and they leave no remembrance after them; but the ſilkworm leaves behind it ſuch beautiful, ſuch beneficial monuments, as at once record both the wiſdom of their Creator, and his bounty to man.

The matter out of which the ſilk is formed is, while contained in the ſilkworm, only a fine yellow tranſparent gum, contained in two veſſels as thick as a groſs knitting needle, and, when unfolded, about ten inches long; theſe open cloſe to one

one another in two exceeding ſmall orifices below its mouth; on which account it is, that though the ſilk thread as it is ſpun ſeems only ſingle, yet it is in reality two threads ſticking ſlightly together by their ſides from beginning to end, and they may be eaſily ſeen and drawn aſunder by the help of a microſcope, or even without one. This gum is of a particular ſpecies, neither diſſolvable in water nor ſpirit of wine, though they will a little ſoften it, and it receives its firmneſs and tenacity immediately upon the ſilkworm's drawing it out in a thread, by the air exhaling its moiſture.

I take this gum to be of the nature of horn if it were in the ſtate of a jelly; for the ſilk veſſel, being taken out of the worm and hung up, will, in a day's time, become quite dry and hard, not differing in appearance from a piece of tough yellow horn, and having the ſame ſmell when burned: thus ſilk will be only an exceſſive fine hair, with ſome ſmall portion of gum on its ſurface, of ſuch kind as water can diſſolve, and which cauſes ſeveral of theſe hairs to cling together when they are reeled out of warm water, and it is this

diſſolvable

diſſolvable part of the gum which occaſions the waſte ſuffered by ſilk in boiling it; but there is a much greater waſte than this would occaſion when the ſilk is artificially gummed, as is ſometimes fraudulently done, to increaſe its weight, or to make it lie ſmooth when they comb it to conceal what has been ill reeled.

The ſilkworm can fix and form its ball in any angle, or hollow place that is nearly of a ſize with the ball; it generally roams about for ſome time among the branches, till, having got a fit place, it begins its work by firſt ſpinning thin and irregular threads which are to ſupport its future ſtructure; upon theſe it doth, on the firſt day, form a ſort of oval of a looſe texture, which is called the floſs-ſilk; within this, on the ſubſequent three days, it forms the firm and more conſiſtent ball of ſilk; it remains always on the inſide of the ſphere which it is forming; during its work it reſts on its hind part, and with its mouth and forelegs faſtens and directs the thread. This thread is not directed in continued rounds on the inſide of the ball, but is ſpun in ſpots forward and backward, in a ſort of wavy figure; and this is the cauſe why a ball,

ball, in winding off its ſilk, will perhaps not turn once round while ten or twelve yards of ſilk are drawn out.

At the end of three or four days the worm has uſually finiſhed its ball, in ſize and ſhape like a pigeon's egg; the inſide of it is generally ſmeared with a ſort of gum of the ſame nature with that out of which the ſilk is formed, and which ſeems deſigned in their natural ſtate to keep out the rain, for it reſiſts the wet ſo well, aſſiſted by the ſilk which is round it, that the balls, when put in hot water to reel them off, ſwim on the top like ſmall bladders, not admitting it within ſide unleſs they are imperfectly formed, or the ſilk almoſt quite reeled off. When the ſilk-ball is finiſhed, the ſilkworm, being now much ſhortened and wrinkled, ſo that the rings of its body appear very deep, reſts a while, and then throws off its ſkin; this is the fifth time of its moulting, though not mentioned among its other moults, becauſe it doth not interfere with your management: and now, upon opening the ſilk-ball, you would ſee it in the form of a *grub* or *chryſalis*, in ſhape ſomewhat like a kidney-bean, but pointed at one end, having a brown ſmooth

ſkin

ſkin compoſed in rings, and the worm's ſkin which it threw off lies in the ball with it.

In this form it continues, according to the different heat of the climate, from fifteen to thirty days; in *England* it is thirty, reckoning from the time of its beginning to ſpin; it then throws off the grub's ſkin, which may be called the ſixth moult, and has now the compleat form of a large white moth, with four wings, two black eyes, and two horns or antlers branching ſideways, like two very ſmall black feathers. It then immediately begins to moiſten the end of its ſilkball with a clear liquor which it throws out of its mouth; and thus ſoftening the gummineſs of the ſilk, it, by frequent motions of its head, looſens the texture of the ſilk, but doth not break it, and thus widens a paſſage by which it comes forth in the form of a moth, as deſcribed above.

Though the ſilk is not broken, yet the balls which are thus pierced by the moth can never be reeled off, on account of the fuzzy burr of ſilk which is raiſed and looſened at the hole where the moth comes out, which immediately entangles the threads

threads upon attempting to reel them; therefore, that you may reap the advantage of the worms, it is neceſſary that the chryſalis or grub ſhould be killed in thoſe ſilk-balls which you have not leiſure to reel off before the time of the moth's piercing them; after having firſt made choice of a ſufficient number of balls to breed from; the manner of chooſing them I ſhall give in the following chapter. But here I muſt mention one thing which I had forgotten, and this is, that after the ſilkworm has begun its firſt looſe threads, it generally lets fall a drop or two of moiſture, the more in quantity as the ſeaſon has been wet; at the ſame time it evacuates its laſt litter, which is very glutinous and moiſt; and by thus emptying itſelf before it is incloſed, it avoids fouling the inſide of the ſilkpod.

CHAP. IV.

Of diſbranching the arbours where the worms ſpin. How to chooſe thoſe ſilkpods which are deſigned for breed, and ſort thoſe which are to be reeled.

THE time in which the ſilkworms finiſh their ſilkpods varies according to the weather; if it is warm and dry, the worm makes quick diſpatch; but if it is cold or moiſt, they are languid, and ſpin ſlowly. You may know whether they have finiſhed by ſhaking the pod in your hand, for if the chryſalis is looſe and rattles in it, this is a ſign they have done ſpinning, that is to ſay, all that began to ſpin at or near the ſame time with the one on which you make tryal. In three or four days after the time when the worms began to ſpin, you may generally gather their balls or ſilkpods from among the branches. Begin with thoſe ſhelves where they ſpun firſt, taking the branches and twiggs down regularly, and pulling the balls from among them ſucceſſively as you take them down.

In

In gathering the balls you ſhould make four different ſortments of them, for which purpoſe place four different baſkets, in one of theſe place gently thoſe which are deſigned for breed; in another put all thoſe which are double, having two worms in them; in the third put the firmeſt and hardeſt of thoſe which are to be reeled; and in the fourth thoſe that are of a looſer texture. Thoſe which are very thin, unfiniſhed or imperfect, may make a fifth ſort.

Let your choice of thoſe which are for breed, be always from thoſe ſhelves or arbours where they ſpun earlieſt. Chooſe from theſe the largeſt, the firmeſt, and the deepeſt coloured balls, that your breed may be ſtrong and healthy. For if you make uſe of ſmall, or ſoft and imperfect balls, which are the produce, generally of ſmall and weak worms, your future broods will degenerate, both in ſize and vigour, and give you vaſtly more trouble, and leſs profit than ſtrong and healthy ones.

In chooſing theſe balls you muſt, as well as you can judge, take an equal number of males and females: the balls which contain the males are generally more taper

and ſharp at the ends than thoſe which hold the females, which are more blunt and round at the ends, and ſomewhat more ſwelled in the middle; the reaſon of which is, that the female, having a groſſer body as being full of eggs, adapts its ball to this form. You might miſtake thoſe which are ſpun double for females; but beſides, that theſe are of an extraordinary ſize, you may diſtinguiſh them by their clumſy ſhape, which is rather round than oval, and a little obſervation will make you pretty expert in this knowledge. You cannot however expect to diſtinguiſh exactly equal numbers of males and females, there may after all be a conſiderable difference, and therefore you may keep as a ſuperfluity, ſome of the beſt among thoſe which are ſpun double, and when the moths are come out (for you will then eaſily diſtinguiſh the males and females) you may add from theſe to the ſide that was defective. A *French* writer has indeed hinted that theſe double balls would produce worms, which would alſo ſpin double balls, and that therefore they are improper to breed from; but this has no foundation, ſince it is accident, or a con-

confined place which brings two worms to ſpin in one ball; and therefore the largeſt and ſtrongeſt of the double ones would be as good as any for breed; and as they can't be winded off would be ſo much ſaved: but as they are twice as ſtrong as the ſingle ones, the moths cannot well make their way out, therefore you had beſt cut them with a pair of ſizars, and take out the chryſalis, which being laid in a box, and covered about an inch thick with chaff, will change to a moth as well as the reſt.

An hundred males and an hundred females will together produce about an ounce of eggs, from which computation you may determine what number of balls you will keep for breed; and you ſhould rather keep too many than too few, to prevent failures which may happen either in the moths coming out; or their breeding; or the eggs which are to be kept till the enſuing year, ſome of which generally decay.

The balls which you chooſe for breed being thus fixed upon, take a pretty ſtrong thread and with a needle paſs it through the outer ſilk of the balls, taking care not to hurt the animal which is incloſed, and

having filled a thread of three or four foot long in this manner, tie the two ends of it together, and hang it up out of the reach of rats or mice, which would infallibly deſtroy it. Proceed with the reſt of the balls deſigned for breed in the ſame manner, and ſtring the ſuperfluous double ones by themſelves. Let them all be hung up in a temperate ſituation, if it is a hot climate, but, if it is a cool climate, a warm room will haſten the coming out of the moth. The moth will the eaſier make its way out if before you ſtring the balls, you ſtrip off the outer floſs; and if you ſtring the males and females upon ſeparate threads it will have a convenience which will be mentioned hereafter in the directions about breeding.

The reſt of your ſilk-balls which are to be reel'd, muſt either be reel'd off directly, or, muſt be proceeded with ſo as to prevent the moths piercing them, till you have leiſure to do it; for though the ſilk of thoſe balls which are reel'd off without keeping is ſaid to appear ſomewhat more bright and gloſſy, yet there will be no difference in the goodneſs of their ſilk, and of thoſe in which the grubs are killed, in

order to preſerve them till you have time, provided you kill them in a proper manner; beſides where you have a great quantity of balls it cannot be expected that you ſhould be able to reel off many before the time of the moths piercing; therefore you muſt be careful in preventing this, which, if it happened, would be an irreparable loſs; and thus by having all the balls in a condition to wind them off at your leiſure, you will be able to go the more regularly about it, and to reel off their ſilk to greater advantage and perfection.

Moſt perſons in the countries where ſilkworms are bred, do not reel off their balls, but ſell them to thoſe who make this their buſineſs; and there is no doubt but that all manufactures are the more expeditiouſly carried on, the more branches they are divided into: yet where perſons who breed ſilkworms have leiſure and conveniency, they will conſiderably increaſe the profit of their ſilk by reeling it themſelves. Three thouſand three hundred ſilkpods, with the chryſals in them weigh about twelve pounds, and may be worth about eight ſhillings, according as the ſilk

ſeaſon has prov'd favourable, or not; theſe twelve pounds will make about ſixteen ounces of reel'd ſilk, which is worth near ſixteen ſhillings, beſides about eight ounces of floſs. So here then the reeling of the pods doth double the profit.

You will ſee the advantage of ſorting the balls, as mention'd in this chapter, when you come to that part which treats of winding the ſilk; I proceed now to the method of killing the grubs, to hinder the balls from being pierced.

CHAP. V.

The methods of killing the Grub or Chryſalis, to prevent the Silk-balls from being pierced.

THE ſorting and ſeparating of the ſtrong, hard, and thick ſilk-balls, from the thin and ſoft ones, as directed in the foregoing chapter, will be of ſome ſervice, when you intend to kill the grubs within them, in order to prevent their piercing; for as this is done by the means of heat, the thick and hard balls will require to be placed where the degree of heat

is

is greateſt, that it may penetrate more effectualy through their thick and hard ſubſtance. There are three methods of ſuffocating the grubs in the ſilk-balls: firſt by the ardent heat of the mid-day ſun; ſecondly by the heat of ovens; thirdly by the ſteam preceeding from ſcalding water; in the firſt and the third of theſe methods there is no danger of the heat injuring the ſilk, and therefore they are to be preferred, when your convéniency permits.

In order to kill the chryſals or grub by the heat of the ſun, you muſt chooſe a clear day, without clouds or wind; about ten or eleven of the clock, ſpread the ſilk-balls to its rays, and letting them remain in this manner for about four or five hours; wrap them up cloſe in coarſe cloths, which ſhould alſo have been expoſed to the ſuns heat, to the end that their ſtifling warmth, added to what the balls have before received, may the better anſwer the intended effect. If the cloths were black or of a dark colour they would conceive the heat better, and after the worms are wrapped up in them, they ſhould remain in the ſun's heat ſo long as you perceive it can preſerve any conſiderable warmth in them.

The beſt ſituation for expoſing the balls to the ſun is before a ſouth wall, or in the angle between two walls which lies open to the ſouth, if ſuch can be obtained, the reflection from the walls giving an additional heat.

It is hard to determine the time which is neceſſary to kill the grubs; in the more temperate climates, the balls will require to be thus expoſed three or four ſucceſſive days; the colder climates ſuch as *England*, will not do it at all effectually, and, even in the hot ones, you may be diſappointed in the weather, and be obliged to repeat the operation, or, at laſt, to have recourſe to the heat of the oven, or the ſteam of ſcalding water.

The beſt method to determine the leaſt time which is neceſſary to kill them by the heat of the ſun, is by expoſing a few during different lengths of time, and then obſerving which is the leaſt time which can effectually prevent the moths from piercing, by opening the pod and ſeeing if the grub is kill'd: you may make this tryal while you are expoſing to the ſun all your ſilk-balls, but the experiment can only be of ſervice to you the enſuing ſeaſon, for you

you muſt make ſure of the balls which you intend to wind off; and it is better to overdo than not to expoſe them ſufficiently. After having wrapped the balls up in cloths as directed above, keep them ſo while any warmth remains; and take care not to admit the cool air to come at them, elſe the chryſalis may recover and pierce the balls.

The heat of an oven, ſuch as it has after the bread is drawn, will generally kill them; but this requires nicety and attendance, for if it is too hot, or they remain there too long, it will ſcorch and injure the ſilk; and if too cool the grub will recover as above: the balls ſhould be put in baſkets, or in ſome ordinary bags that they may not be ſcorched by touching the ſides of the oven; it might alſo be of ſervice to moiſten the bags, in order to prevent this ſcorching; the oven mouth ſhould be well ſtopped, and in about a quarter of an hour after they have been there, it will be time to take them out; eſpecially if upon liſtening you hear a ſmall crackling noiſe come from them; after taking them out, you muſt wrap them up in cloths made hot, as was before directed

in

in killing them by the heat of the ſun; and, when they are quite cold, expoſe them to the air, or to the ſun, becauſe the heat of the oven will make ſome moiſture ſweat out of the grubs which are killed, which ſhould thus be dryed up, leaſt it rot or injure the ſilk. It is adviſed alſo by ſome to take the floſs off before you put them into the oven, becauſe, being very delicate, it is apt to be ſcorched and injured; but if this is neceſſary, it would take up too much time, which at this juncture might be very dangerous, eſpecially if it was near, the time in which the moths pierce the ſilk-balls.

The third method of killing the grub or chryſalis, which is by the ſteam of boiling water, is preferable to either of the others, as it performs the work without any injury to the ſilk, and alſo with certainty and expedition; and, ſurely, ſome regard is to be had for creatures which die for the uſe of man, ſo as to kill them as quick and with as little torture as poſſible: it may be done in the following manner.

In a large wooden veſſel, ſuch as thoſe uſed in brewing; put about two foot depth of boiling water; over the water fix an hurdle

hurdle of wicker, fitted to the inside of the veſſel, about an inch diſtant from the water: you may fix it thus by driving three or four nails, which ſhall ſupport it firmly at this diſtance.

Having fixed the hurdle firmly, and alſo ſupported it by a prop in the middle, if it is liable to bend, throw over it a coarſe woollen cloath, or ſomething of the nature of taylor's wadding, which will eaſily let the ſteam paſs; and on this place the ſilk-balls, covering them cloſe with a thick ſtrong cloth. You may pile them about four inches, or as high as the ſuffocating ſteam of the water can reach, which you may judge of, by putting your hand under the cloth which covers them; when they have been there long enough for the ſteam to get through them, for if the heat there is uneaſy for the hand to bear, it is ſufficient, and an hour or two continuance in ſuch heat will kill the chryſalis.

When the water cools, ſo as not to be uneaſy to the hand, it muſt be changed for other boiling water, therefore you ſhould have a kettle conſtantly on the fire to ſupply you, and one ſupernumerary veſſel which you ſhould fill with boiling water when

when any of the others do not retain ſufficient heat to kill the chryſalis, and thus the water which was uſed but ſtill retains ſome heat, being poured again into the kettle, will ſoon boil, ſo as to furniſh you with freſh ſupplies. It would make this method of killing the worms, by the ſteam of boiling water, much more commodious, if, inſtead of placing them on the hurdles as before directed, you proceeded in the following manner, viz.

Have a broad but ſhallow wicker baſket made, pretty open in the twigs, and of ſuch a ſize as will fit and go into the kettle or boiler; it ſhould be of ſuch a depth as you find by experience, the ſteam can penetrate through the heap of ſilkballs; this baſket ſhould alſo have a wicker cover, to ſhut over the ſilkpods which are put into it.

Having filled it with pods, ſhut the cover, and let it down to within an inch of the hot water, ſupporting it by nails, as you were directed in uſing the hurdle, then cover it with a cloath. After it has remained in this ſituation, till you think the chryſalis is killed in the lower part of the pods, take the baſket out, and turning it upſide

upſide down, fix it in the ſame manner as before over the ſteam, thus will the pods which were before uppermoſt be now next the water. Thus when they are ſufficiently ſtoved, pour them out in a heap on a blanket made very hot, and wrap them up cloſe, but not ſo as to bruiſe them, that by this continued heat you may be more certain of having killed the chryſalis; then fill the baſket again, and proceed in the ſame manner till all your balls are ſtoved.

When the balls are cold in the cloth where they were wrapped, they ſhould be ſpread in the ſun, or in an airy place to dry any moiſture which they may have gotten from the ſteam of the boiling water. If the weather is not favourable for drying them abroad, you may do it by ſpreading them on the ſhelves of hurdles where the worms were fed, at the ſame time opening the windows, that the air may have a free paſſage. You may, after they are quite dry, heap all the balls on the ſhelves of the ſtands till you have occaſion to reel them of; they will be more ſecure here than if laid on a floor, where rats and mice may get at them, and will gnaw and deſtroy a great many for the ſake of the grub

grub which is in them. Therefore if the place where you fed the ſilkworms was liable to be infeſted with rats or mice, beſide laying traps for them, you ſhould guard the feet of the ſtands, by ſtringing ſome ſharp thiſtle-burrs on a thread, and wrapping it two or three times round each of the feet, cloſe to the lowermoſt ſhelf, which ſhould be at leaſt fourteen inches from the floor; this will ſecure both the worms and the ſilkballs from being preyed upon. The thiſtles are moſt fit for this purpoſe when their flower begins to decay, before they begin to open and ſhed their down and ſeeds.

Having thus ſecured your ſilkballs ready to be winded off at your leiſure, you will not be hurried in that buſineſs, for the balls might now be kept for ſome weeks; they will however wind off eaſier by not being kept too long, which is apt to harden the gum which binds the threads together, and if they are kept till the grub withers, they cannot be reeled, not having weight ſufficient to keep them down in the hot water, beſides they will ſoon ſmell very offenſively.

Having

Having thus brought your ſilkballs into ſuch a ſtate, that you need not be anxious about any miſchief happening to them, it is time that you give ſome attention to thoſe which were ſeparated for breed, the method of managing which I ſhall now proceed to.

CHAP. VIII.

The management of thoſe ſilkpods which were choſen for breed. The coming out of the moths. The method of coupling them. The materials proper for them to lay their eggs on, and how to preſerve the eggs till the next ſpring.

THERE is nothing of greater importance in the management of ſilkworms than that of obtaining a ſtrong and healthy breed, whether you regard the trouble which it will ſave you in feeding, or the advantage of their ſilk. Every method therefore which improves the breed is carefully to be attended to, for when you have once got a good kind you can eaſily keep it up, but if you let your worms degenerate and

and breed promiſcuouſly, the weak with the ſtrong, in a ſhort time you will have none fit to raiſe a good breed from.

I have already given directions how to make choice of ſuch ſilkballs as are proper to breed from, and how to ſtring and hang them up, the next thing you muſt expect to ſee is the coming forth of the moth. The time of its coming forth is various, according to the warmth of the ſeaſon and climate; in *Spain* and *Italy* it is about eighteen days from the time of the worm's ſpinning; in *France* about three weeks, in *England* and *Ireland* about a month. However, you may haſten the coming out of the moths in the colder climates, by hanging the ſilkballs in a warm room, ſuch as a bed-chamber, or where there is a fire generally lighted, againſt the ſide of the room oppoſite to it; and this in the colder climates is very neceſſary, that the cold weather may not have advanced before the time of their laying their eggs, which would hinder their doing it in perfection.

When the moths are near the time of their coming forth, the ſtrings of ſilkballs ſhould not hang ſo as to bear againſt the wall, becauſe ſome of the balls might preſs

preſs againſt it in the place where a moth was to come out, which is always through one of the ends of the ſilkball; for which reaſon alſo, in threading them you ſhould have run the thread acroſs the ſide, that the two ends of the ball may not bear upon one another; and if you had hung the ſtring upon two nails about three inches aſunder, the ſides of it would not touch one another, ſo as to hinder the eruption of the moth.

The moths generally come out in the morning, and cling with their feet to the outſide of the balls; ſome odd ones may chance to fall, and if the place is ſubject to have rats or mice they will deſtroy them; cats will alſo infallibly kill them. To prevent any accidents, you may place a ſtrip of paper under each ſtring of balls, which will receive thoſe which fall.

When you chooſe the balls for breed, I adviſed the putting the males and females on ſeparate threads, becauſe if they were on the ſame, they would begin to flutter about and couple as ſoon as they came out, and would hinder that regularity which you ſhould obſerve in putting them together. You may chance indeed to miſ-

take ſome males for females, and the contrary, while they are in the ſilkballs; but this is of no conſequence, for when the moths come out they are eaſily diſtinguiſhed, the females having a large round belly, their colour ſomewhat whiter, and their horns not ſo large nor ſo black as the male; beſides the difference of ſhape, which in the body of the male is more ſlender and ſharp at the end, you will obſerve him fluttering his wings with great quickneſs, and moving about with activity; whereas the female remains very quiet, and ſtirs her wings very little. When you find the moths are come out of the balls, you ſhould nail againſt the ſide of the room a piece of ſmooth woollen ſtuff, no matter how old and ordinary, about a couple of yards broad every way, or in proportion to your number of moths; then, by means of two or three ſhort threads faſtened to its lower edge, you may turn this edge up about three or four inches, and faſtening the other end of the threads a little higher into the ſtuff, fix two or three ſhort ſticks ſharpened at the ends, to make the lower edge of the ſtuff ſtand out from the wall, like a kind of ſhelf, about three or four inches

inches broad. This will hinder any of the moths, which are to be coupled on the ſtuff, from falling to the ground.

Now take the moths gently from off the ſilkballs to which they cling by their claws, and place them by pairs, a male and female together, on the above-mentioned piece of ſtuff, to which they will faſten by their claws, and, having purged themſelves of a liquor, in colour like brick-duſt, which ſpurts from their bellies in a ſmall ſtream, the male and female will couple together.

You may, in thus pairing them, put the ſtrongeſt and largeſt nigh one another on the ſtuff, and you may quite reject thoſe that are very ſmall, weak, or ſome-way injured, by which means you will further meliorate the breed.

You ſhould have another piece of ſtuff, hung in the ſame manner with that already deſcribed, in a different part of the room, and, as often as you find the moths coupled, take them off the firſt ſtuff, and place them, thus coupled together, on this ſecond one; by which means you will avoid any confuſion, which might ariſe from your not knowing which had coupled and which had not.

When they have remained thus coupled, on the ſecond piece of ſtuff where they were placed, about eight or nine hours, which will be till the evening of the day when you placed them there, you muſt ſeparate them by gently drawing them aſunder, the male from the female; the male may be thrown away as of no further uſe, unleſs you happen to have a ſuperfluity of females, and then you may keep a few of the males which remain moſt vigorous to pair with them. It is better however, if you can ſo adjuſt it, to let none of your moths couple a ſecond time; for the eggs produced thus are not ſo good, nor do they give ſo ſtrong a breed as thoſe which are laid after the firſt pairing. In ſeparating the male and female, take care not to hurt the latter; you muſt draw them aſunder ſoftly and gently, taking ſome time to do it, and if you find any which will not come aſunder without danger of hurting, quit them for ſome little time and go to others, after which you may return to theſe. Some hold them by the wings while they ſeparate them, but I think if you hold them gently by the body, it does as well.

The

The reaſon of ſeparating the males and females, and not waiting till they uncouple of themſelves, is, becauſe their vigour being now but of ſhort duration, the female ſhould have time to lay her eggs while ſhe remains in ſtrength, whereas, if you left them to uncouple of themſelves, they would frequently not do it in leſs than two days, eſpecially in the more temperate climates.

You ſhould viſit the moths at times, while they are paired, and ſhould bring together thoſe that wander out of the way, and thoſe which uncouple too ſoon, that is to ſay, in an hour or two, that they may pair a ſecond time.

Before the moths are unpaired, whether they do it of themſelves or by your means, you ſhould have in readineſs proper materials for the females to lay their eggs on. The fitteſt things for this purpoſe are the leaves of the walnut-tree, or ruſhes, which laſt you may cut to the ſize of any broad drawer, and ſpread ſo as to cover its bottom. From both theſe you can with great eaſe ſeparate the eggs, in order to preſerve them in little boxes till they are to be hatched in the enſuing ſpring; but do not by any means let the moths lay their eggs

upon paper or linen, for to theſe the eggs will ſtick ſo faſt, that it will give you vaſt trouble to get them of, and even that cannot be done without bruiſing many of them, and ſcraping off a great deal of down along with them, which is apt to obſtruct and entangle the young worms when you come to hatch the eggs. Some uſe the ſmootheſt ſort of woollen ſtuff, which has no pile, for the moths to lay their eggs on, and afterwards ſcraped them off with a blunt knife; this is better than paper or linnen, but yet is nothing comparable to the walnut leaves or ruſhes.

The drawers in which you fed the worms when young may ſerve to put either the walnut leaves or ruſhes in; or if you have not drawers enough, tables or ſhelves, which are out of the way of all vermin, and creatures which might injure the moths or eggs, may ſerve; for, beſides rats and mice, ants and crickets are ſaid to deſtroy the eggs, as will birds and poultry; cats or dogs would alſo kill or diſturb the moths.

The walnut leaves or ruſhes being prepared, take firſt thoſe female moths which had ſeparated of themſelves, and place them

them upon them; then ſeparate the others which remain coupled, in the manner before directed in this chapter, and place them alſo on the leaves or ruſhes, and ſo proceed with the reſt of your moths after they have coupled the proper time of eight or ten hours. The males are to be thrown away, and none of them to be left among the females which are laying their eggs, for they would only diſturb and hinder them. In putting the moths on the leaves or ruſhes, you may place them ſo throng, that there will be about twice ſo much ſpace empty as what they cover, which will leave ſufficient room to lay their eggs.

If you make uſe of a ſmall net of the ſize of your drawer, looping it over the heads of a few ſmall nails all round the edge of the leaves or ruſhes, and proping the middle with a piece of bulruſh (becauſe they will lay their eggs on the prop) about three or four inches long, to keep the net from preſſing on the moths, you will by this hinder them from creeping off the ruſhes, and laying their eggs againſt the ſides of the drawer, from which you would find it very troubleſome to ſeparate them. Or you may with a needle and thread

ſtring ſome ruſhes, ſo as to make a ſort of mats, and fix them all round the ſides of your drawer for the moths to lay their eggs on, otherways you muſt viſit them oft, and replace ſuch as creep from the ruſhes.

On theſe leaves or ruſhes the moths will lay their eggs, each moth will lay about four or five hundred, more or leſs, according to their ſtrength and fecundity; ſo that an hundred females will produce about an ounce of eggs. The eggs ſtick, to whatever the moth lays them on, by a natural gum with which they are ſmeared; they are firſt of a pale yellow colour, then greeniſh, afterwards they grow ſomewhat red, and in about four or five days after being laid, they attain a blueiſh grey colour; this happens ſooner or later, as the weather is favourable; and of this colour they always remain, unleſs they afterward happen to be damaged by too great cold, heat, or moiſture in keeping them. The eggs which do not get this blueiſh colour, but remain yellow, are good for nothing, having not been impregnated by the male.

When the moths have done laying, or begin to lay but ſlowly, and thoſe eggs ſmall, you may take them off the ruſhes or

leaves

leaves, and put them upon ſome leaves ſtrowed on a table, where they may lay the reſt, which ſhould not be mixed with your firſt layed eggs, becauſe they will not be ſo good, and many of them will not change to the blueiſh colour. If the ruſhes from whence you took the moths after laying are not very full of eggs, you may put other moths on them to lay, but if they are full, take them away, and place others in their room.

When the moths have done laying, and the eggs have attained the proper colour, you muſt take the ruſhes, and rub the eggs off gently, by drawing them through your nails over a drawer, that none of the eggs may be ſcattered. They will very eaſily ſeparate either from the walnut leaves or ruſhes, eſpecially when theſe are a little withered, (for they ſhould be green and freſh when the moths are placed upon them to lay) either by rubbing them gently, or where the eggs ſtick ſomewhat more faſt, by looſening them with your nails, or a blunt knife; but indeed moſt of them will come off upon the leaſt rubbing.

As often as you ſeparate any quantity of eggs from the ruſhes or walnut leaves, you ſhould

ſhould put them into a glazed earthen veſſel, and cover the veſſel with a plate or ſawcer, to prevent any injury from rats, mice, &c. after which place it in a cool, but not a moiſt part of the houſe, and there let it remain ſo long as the weather continues moderately warm, for fear of bringing the eggs into a tendency to be hatched. When the weather begins to grow cold, pour the eggs into clean little fir-deal boxes, ſuch as thoſe made to keep wafers, and ſhutting their lids cloſe, place them in a cheſt of drawers among woollen or ſilk cloaths, but not among linnen, it being apt to draw moiſture to it; or you may put the boxes among the floſs-ſilk which came from the outſide of the ſilk-balls, and thus they are to be kept till the enſuing ſpring.

The place where the cheſt of drawers ſtands ſhould be ſuch as is neither expoſed to moiſture, heat, or cold; for moiſture rots many of the eggs, and on this account too, thoſe who let them be laid on paper, and keep them ſo all the winter, will have many decayed ones; for paper draws moiſture to it. Heat is to be avoided, becauſe it might bring the eggs to hatch before

fore their time; and great cold would mortify them as effectually as moiſture; a bed-chamber therefore is a proper place to keep them in, but not near the fire; and if the weather grows warm before the mulberry leaves open in ſpring, they ſhould be removed into a cooler place, to retard them till there is food for the worms. Obſerve alſo, that if the weather is cold or moiſt when the moths are put to couple or to lay their eggs, it ſhould be done in a place with a fire in it, otherways they will not lay many, nor ſo good.

PLATE I. FIG. IV.

A. ſhews the manner in which the pods kept for breed are ſtrung and hanged.

B. ſhews a little ſhelf of ſtiff paper or paſte-board hanging under the eggs, to receive any moths which chanced to fall.

FIGURE V.

Repreſents the cloath, on which the moths are to be put to couple, placed againſt the wall; its lower edge A B. turned up by means of two threads C C. to hinder the moths from falling.

N. B.

N. B. The chief reaſon for placing this cloath againſt the wall is, that the red liquor which the moth throws out may not fall upon the cloath. If the moths do not cling well to it, but fall in crowds to the bottom; it is then beſt to ſpread it on a table.

CHAP. IX.

On the breed of Silkworms degenerating. An experiment propoſed to be tried, in order to hinder it. Another experiment of curioſity propoſed for tryal.

SOME *French* authors ſay, that it is neceſſary to renew the breed of ſilkworms every four or five years by eggs brought from other countries that are warmer or more natural to the worms, as from *Spain* and *Sicily* to *France* and *Italy*, and that without this renovation the breed will degenerate in four or five years. It may however be ſuſpected, that much of this degeneracy is owing to perſons not being careful to raiſe their breed from a healthy and ſtrong ſtock, according to the rules

rules already given in this treatiſe, among which that of ſteeping the eggs in warm wine, or even warm water, and ſeparating the ſmall and weak ones which ſwim, ſeems of great uſe, and no diſadvantage, becauſe if you want a ſufficiency of eggs, you may rear and feed thoſe which ſwim, but you ſhould not breed from them.

Yet ſuppoſing even what is ſaid of renewing eggs by thoſe brought from different countries to be neceſſary; in caſe I was obliged to have eggs from a climate which was warmer, it ſhould not be to raiſe an entire new ſtock from them, but only to croſs the ſtrain, between ſome of the beſt of them, and the ſtrongeſt of my own which were already naturalized; becauſe it often requires ſome time to make the conſtitution either of plants or animals adapt itſelf to the change of climate.

But another kind of degeneracy, as I imagine, may proceed from the worms being fed, and kept in a manner which differs a great deal from their natural way of living; for as you cannot reap any advantage from them but by keeping them in houſes, becauſe of the injuries they would be liable to both from birds and the

weather,

weather, they by theſe means have neither the advantage of air or exerciſe; their food is conſtantly ſupplied, and they are pampered and full fed without having any labour of ſearching about and going from one branch to another, which they are obliged to do in their natural ſtate. Now though this method of your ſupplying them with food is unavoidable, and though it may for the preſent make them large, and produce a great quantity of ſilk, yet I think it muſt at length cauſe the breed to be leſs healthy, and leſs fit for propagating ſo ſtrong and vigorous, or ſo numerous an offspring as the worms which enjoy a free air, and are forced to move about and hunt for their food: for I believe it will be allowed that if a cock and hen were confined to breed in a coop, and their offspring to do the ſame, the breed would ſoon loſe its mettle, and degenerate.

To prevent this degeneracy in the health and vigour of ſilkworms, and to continue the breed in full perfection, I would propoſe an experiment, viz. that a few might always be bred wild on the mulberry-tree, with the beſt of which you might croſs the ſtrain of your own breeders. To effect

fect this, in climates where the weather will not injure the worms, no more care need be taken, than to ſecure them from birds; and you might perhaps do it, in the following manner.

Take as many as you think proper of your firſt hatched worms, and throw ſome freſh leaves on them, in order to divide them ſo, that there may not be above a ſcore on each leaf; when you have thus divided them, faſten each leaf with the worms on it by pinning them here and there among the ſmall branches of the mulberry-tree, and ſecure them from birds by covering the tree with a net. If the tree was trained againſt a wall it might be the more convenient, becauſe its leaves would be the more forward, and it would not be liable to be ſo much ſhaken by winds; you could alſo the eaſier ſecure it by a net, which you might fix in ſuch a manner as to be at ſome little diſtance from the leaves, ſo that no bird could come at any of the worms; this might be done by ſome covering of boards or ſuch like, which, projecting from the top of the wall, might have the net hung to it, and would be an additional advantage againſt perpen-

perpendicular rains and dews; however, you ſhould chooſe a wall with an aſpect toward the leaſt rainy point, but the north aſpect muſt be excepted; the net alſo ſhould come cloſe to the wall on the ſides of the tree, and be faſtened with wooden pins to the ground. By this method the worms may perhaps without danger ſubſiſt themſelves in their own wild and natural ſtate, and may afford you not only an agreeable entertainment, but alſo ſome uſeful obſervations, drawn from the worm's own natural œconomy.

When theſe worms are ready to ſpin, they will find convenient places between the wall and the branches of the tree, and, as ſoon as they have finiſhed their ſilk-balls, you ſhou'd take them down, and ſtringing the beſt of them, keep them in the ſame room with the reſt of your balls deſigned for breed, that the moths may come out about the ſame time; and then pair the wild males with the houſe bred females, and the wild females with home bred males, as far as their number and time of coming out will conveniently anſwer; the better to effect which, you might mark ſome of your own ſhelves for breed, which went to ſpin at the ſame time with theſe

wild ones, if the worms on thoſe ſhelves were ſtrong and healthy, although not the firſt that went to ſpin: or you may haſten or delay a little the time of either coming out, ſo as to make them anſwer, by a ſmall difference in the warmth of the place where the pods are kept when ſtrung.

The foregoing method may be tryed in thoſe countries which are not ſubject to ſuch rains, winds, or cold, as would hurt the worms. The following one for trying to keep ſilkworms on ſmall trees within doors is propoſed as a matter of curioſity, for thoſe who keep them only for amuſement, which if it ſucceeds, will ſave the trouble of attending and feeding them.

For this end get two or three young mulberry-trees as buſhy, and full of branches as you can procure, and of ſuch a ſize as that when placed in pretty large but flat boxes of earth, they will paſs through the door of the place where they are to be fixed. Theſe trees ſhould be ſuch as ſpread into branches within about half a foot of the ground, that by theſe means they may have the larger heads and more leaves, and yet paſs the eaſier through the door, which they will alſo the better do if they are of a

flattiſh form; if they were not originally trained to this form, you may bring them to it when you are going to make uſe of them, by bending the branches alternately acroſs pretty ſtrong ſticks placed among the branches on each ſide of the tree. And this form will both make the branches lie thicker, and the better enable the worms to ſhift from one place to another; and will alſo give you a fairer view of them: but in bending the branches take care to ſecure them ſo that none of them may ſtart, after the worms are plac'd on them, for this might deſtroy many of the worms.

Theſe trees ſhould be planted in the boxes of earth, with all their roots taken up as whole as poſſible, and at leaſt on the autumn preceeding the ſpring when they are to be uſed; though I think it would be better to tranſplant them in *February*, and to let them ſtand one year in the tubs before you uſed them, and if on tranſplanting you cut off any of the branches, let it be only thoſe which ſhoot ſtrait forward, and which would not ſo eaſily bend to the flat form. They ſhould ſtand abroad in the warmeſt ſituation which you can find, that they may bud the ſooner,

till

till juſt before you want to make uſe of them; and then may be carried into the room which you deſign for them.

Before you put the ſilkworms on the tree, you ſhould take a piece of bays or any ordinary cloth, and making a cut half acroſs its middle, let the ſtem of the tree go into it; then ſew up the cut and bring the cloth cloſe up to the under branches of the tree on each ſide, and fix it, thus ſpread, in ſuch a manner, that if any worms chance to fall, they may be caught by it, and alſo by its lying cloſe to the branches, may make their way up again; then place the worms on it in the ſame manner as was directed in the former part of this chapter, when they were to be placed on the trees abroad.

If you think the weather too cold, or that the leaves are not ſufficiently opened, you may, in this as well as the foregoing method, defer putting the worms on the trees, till they have even paſſed their firſt moulting. Neither ſhould too many be put on a tree, leſt they ſhould have eaten all the leaves before they were ready to ſpin; about two hundred worms will be enough on one of theſe ſmall trees, even

though it is very full of leaves; and the tree ſhould be forwarded by a warm ſituation, ſo as to have its leaves opened to about the ſize of a ſixpence, before you put the worms upon it. However, you may have a ſpare tree in a box for a reſource, in caſe you find any of the others over-ſtock'd with worms, and you may bring the flat part of this cloſe to the flat ſide of that on which the worms are, ſo as that their ſmalleſt branches may a little mix, by which means the ſilkworms will go from one tree to the other, and the over-ſtock'd tree will be eaſed. That the flat part of the trees may the more readily be thus brought together, the boxes were directed to be of a flattiſh form.

While theſe trees are within doors with the worms on them, you muſt take care to give them air by keeping the windows open when the weather is good. You may prevent any moiſture at the bottom of the box from injuring the floor under it, if it is a boarded floor, by placing it on a couple of pretty thick ſquare poſts laid on their ſides, which will keep the bottom at a diſtance from the boards, and give the air liberty to paſs between them. If the

box is pitched on the inſide, it will both preſerve it the longer from rotting, and alſo hinder the earth from drying too faſt, by means of the wood ſoaking up its moiſture; and as the tree while it ſtands within doors, will not have the benefit of rain or dews, the earth ſhould be pretty plentifully watered, eſpecially when the weather is very hot; and there ſhould be a ſmall hole in the bottom of the box cloſe to its edge, to let out any ſuperfluous water which may drop into a veſſel placed to receive it; for which purpoſe the tub ſhould be fixed with a ſmall inclination towards the ſide where the hole is made.

When the worms begin to ſpin, if you think they have not enough of convenient places, you may fix ſome ſprigs of heath here and there among the branches; and thus if the experiment ſucceeds, you may rear ſilkworms within doors in the natural wild manner.

If the leaves of the trees, thus kept within doors, are found apt to flag for want of the evening dews. Perhaps it might be helped by winding three or four united ropes of ſoft tow round the ſtem of the tree, and afterwards ſeparately round three

or four of the principal arms, after which, being again united, their end might lie in a veſſel of water placed or hung above the tree. This rope drawing moiſture from the veſſel of water, would keep the main branches and ſtem conſtantly wet, and by theſe means help to ſupply that great quantity of fluid, which the moſt ſagacious Dr. *Hales* has proved to be perſpired by the leaves; and if the rope drew more than the bark imbibed, the ſuperfluity would moiſten the earth in the box.

CHAP. X.

Of the diſeaſes and mortality incident to Silk-worms.

WITHOUT reckoning thoſe accidents, by which the eggs of ſilk-worms become decayed and mortified before they are put to hatch, and which have been already mentioned; the ſilkworm during the time of its formation in the egg, that is, during the time of hatching, is ſubject to accidents and mortality: theſe have been partly guarded againſt in the directions

rections given for making the eggs hatch. However, I cannot here omit mentioning, that the hatching of eggs in perſons boſoms, as is practiſed in many places, may poſſibly often kill the embryo worm, and make the breeders of ſilkworms wonder at their eggs not producing according to expectation, though they were very ſound and kept in a due degree of warmth; yet this I think may often happen to eggs hatched in the boſom. If the eggs of pullets are ſmeared with any clammy liquid which ſtops the pores of the ſhell, there will no chicken hatch from ſuch eggs, till that which thus ſtops the pores is removed. The perſpiration and ſweat of perſons, who hatch ſilkworms eggs, muſt often pervade the bag in which they are kept, and may produce the forementioned bad effect on many of the eggs; ſome perſons, however, will produce this bad effect more than others, and therefore all people are not alike fit to hatch ſilkworms in this manner.

Indeed, in all the preſent methods of hatching ſilkworms eggs, the freſh air has too little acceſs to them; whether it is done in bags kept in the boſom; or in boxes

kept in the bed, or between pillows. It may therefore be of advantage to open the boxes now and then in a warm place, and ſtir the eggs that the freſh air may have acceſs, and the eggs, by ſtirring them, enjoy an equal degree of warmth; but they muſt be expoſed only a very ſhort time, leſt they cool too much.

It would be eaſy to make a communication between the external air and the box, by means of a ſmall reed or a few quills, and the air which paſſed through ſuch a tube, would be ſufficiently warmed by the pillows before it came into the box: ſuch a tube might alſo be fixed to the top of a little box, fitted to keep eggs in a perſon's boſom or pocket, and then there would be no occaſion for having ſuch box pricked with holes to admit the air thro' the bag which is in it, as I mentioned in the method of hatching the eggs; and the box being cloſe, and only communicating with the outward air by means of its tube, there would be no fear of the perſons perſpiration or ſweat hurting the eggs. A little tube of leather kept open by rings, which could be cut out of a quill, would bend in any direction, either out of the boſom

boſom or pocket, ſo as to communicate with the outward air.

Thus much I have thought neceſſary to hint, in order to prevent any ill conſequence which may be ſuſpected to ariſe from the method of hatching eggs; for I think ſteam and moiſture may hurt them, as much as an improper degree of heat or cold.

Some few ſilkworms are alſo liable to die in hatching by not readily getting out of the ſhell, which, as it is not fixed to any thing, is apt to be dragged after them in their efforts to get out, till growing tired they are not able to extricate themſelves; this, however, happens to but a few, and thoſe perhaps weak worms. But the method in which the eggs muſt be hatched makes this unavoidable, neither is it of great conſequence.

It is likely that eggs often are hurt by not being waſhed, as mentioned in the chapter on hatching; for then many of them will remain ſmeared over with that moiſt ſubſtance, which the moths caſt out a little before they lay their eggs, and this will ſtop their pores in the ſame manner as was ſaid of ſweat or perſpiration. It might

might not be amiſs to waſh them as ſoon as they have got their grey colour, before they are laid up.

The diſtempers incident to ſilkworms after they are hatched proceed, generally, either from their food, or the temperature of the air in which they live. The regimen of their food may err either in quantity or in quality. I have formerly mentioned the manner of regulating the quantity of their food: it will be a pretty ſure rule to avoid giving them too much, if after they have eaten all their leaves, they are left without any for half a quarter of an hour or ſo. But if by any accident they have faſted too long, it is ſafeſt to give them ſparingly and often for ſometime after, and then of the wholeſomeſt and beſt leaves. And if they have ſurfeited by over-eating, let them faſt a longer time, and afterwards feed them alſo ſparingly.

But ſilkworms are much more liable to ſuffer from the bad quality of leaves than the quantity. The leaves of mulberry-trees which grow in moiſt grounds, or in places ſhaded from the ſun, are unwholeſome; and thoſe which grow on ſuckers produced from the trunk, or root, or principal

cipal arms, being full of ſap and moiſture, crude and immature, will produce a moſt dangerous fatal diſtemper in ſilkworms: even by only giving them one feeding, they grow immediately ſurfeited, and throw out of their mouths a greeniſh liquour, and a clear pellucid humour out of the pores of their ſkin, particularly out of the little point which grows near their tail. This clammy moiſture by their rubbing againſt one another cloſes up the vents by which they breath, which are thoſe black ſpecks that appear down each ſide; and I ſcarce ever knew worms recover from this diſorder, ſo as to make ſilk worth any thing. It is therefore much better to avoid the diſtemper than to attempt curing it; however, as all may not be alike infected, pick out thoſe which are in the worſt condition, and if you have a mind to make experiments on them you may. Then make the hurdles of thoſe that remain, clean and dry; and letting them faſt two or three hours, give them afterwards ſome of the beſt leaves you can chooſe, but little at a time, and gathered a good while before.

Du Halde's hiſtory of *China* mentions a powder made of the dried mulberry-leaves in

in autumn, and reſerved for a cure againſt a diſtemper in ſilkworms which he doth not deſcribe. He ſays, they moiſten the freſh leaves and ſtrew this powder on them, being ground very fine. Perhaps it might be good againſt the ſurfeit above mentioned, as hay and dry food would be to cattle. But his account of ſilkworms being a tranſlation from a very antient *Chineſe* manuſcript, and in all likelyhood by perſons who were not acquainted with the ſubject, cannot be depended on. The moiſten'd leaves would, I think, be hurtful.

Mulberry-trees may alſo have peculiar diſtempers in themſelves, which may make their leaves unwholeſome for ſilkworms, but this will beſt be diſcerned in the growth of the tree and of its leaves: and the diſtempers incident to the ſilkworms eaſieſt avoided by not uſing ſuch. Air is the next thing to be conſidered, and my much honoured friend the Reverend Doctor *Hales*, whom ſimple nature choſe for her favourite, becauſe he courted her with candid ſimplicity, has ſhown in variety of inſtances how air affects animals, and by a variety

variety of incomparable contrivances, how it may beſt be turn'd and attempered to the uſes of life.

Now ſilkworms are more liable to be affected by the air, which is perpetually neceſſary to animals, than by any other circumſtance of their lives: ſudden changes from heat to cold, and from cold to heat, are very prejudicial to them, and ſuch climates as are much ſubject to ſuch changes unfit for them. Theſe changes however, can be tempered by art and contrivances, inaſmuch as ſilkworms are kept within doors; but putrid air occaſioned by the worms being either kept too cloſe, or not having their hurdles cleaned, is apt to deſtroy great numbers; yet the cauſe of ſuch diſtemper is eaſily ſeen, for the abundance of their litter, and the ſmell which it ſpreads over the room, are ſufficient indications that the hurdles want cleaning, and that the room wants a ſupply of more wholeſome air. Indeed, a very little contrivance would keep the rooms conſtantly ſupplyed with freſh air, which being a thing of the utmoſt importance, I ſhall here mention an eaſy method of effecting it, which is founded upon that remarkable pro-

property of the air, that when pureſt, it is always moſt heavy; and when mixed with vapour, either putrid, aromatick, or watery, or indeed with almoſt any thing that affects the ſenſe of ſmelling, it is lighteſt.

Now, in any room where ſilkworms are fed, if an aperture, about nine inches ſquare, be made in that angle of the cieling which is fartheſt from the door, and this aperture continued by a funnel of board, till it communicates with the open air, then will the putrid vapours, occaſioned by the litter and the multitude of worms, conſtantly aſcend thro' this funnel, and the pure heavy air will ſucceed by the door in its place; or rather, if an aperture is made towards the bottom of the door, of the ſame ſize with that in the cieling, with a ſmall ſhutter to open and cloſe as occaſion requires; then will the freſh heavy air come into the room with greater advantage, by raiſing up, and carrying of the foul air which is above it: or if two of theſe apertures are made in the oppoſite walls of a room, near to the floor, and opening into the air abroad, they will have this convenience that you can take the advantage

vantage of opening that aperture, which is on the windward ſide, when the room wants to be ſuddenly and thoroughly clear'd of the foul air thus forced thro' the funnel.

If it be inconvenient to carry up a funnel as mentioned above, then an aperture made through the wall, cloſe to the cieling, may ſerve tolerably well to carry of the unwholeſome air, provided you uſe ſome of the apertures which I have mentioned, for the admiſſion of freſh and wholeſome air. Thus, if the proper cleaning of the worms, and the due admiſſion of freſh air be practiſed, the diſtempers ariſing from dirt and putrefaction will be prevented, ſo far as they ariſe from the manner in which people are obliged to keep ſilkworms in houſes; and, until ſuch cleanlineſs and airing of the rooms is obſerved, there will be always complaints, as there are at preſent in the countries which breed ſilkworms, of unaccountable mortality among the worms of ſome perſons, while thoſe of others remain healthy. But the ſmell of the room will give warning of the danger, and point out the beſt cure, which is prevention.

It is true indeed, that diſtempers of the ſame kind may ariſe from ſome peculiar putrified ſtate, or malignancy in the atmoſphere, as in a hot and moiſt ſummer, or in places abounding with mineral exhalations, or ſubject to earthquakes, which let looſe ſuch ſteams. But then, the diſtemper will appear more univerſal, and will more or leſs affect all the ſilkworms in adjacent places; in this caſe, often cleaning the litter away will contribute to preſerve the worms, as alſo not keeping them too much thronged and crowded together. The malignancy of the air may perhaps be in ſome meaſure qualified, by keeping *Benzoin*, or even roſin melted in a pan, ſo as to mix its fume with the air of the chamber; for I find the fume of ſuch aromatick gums recommended in ſome books, but without diſtinguiſhing preciſely for what kind of diſorders; with theſe alſo they mention the fume of hot vinegar, and this laſt, being of known efficacy againſt putrid and peſtilential diſorders, has probably been found uſeful to ſilkworms in ſuch diſtempers, though indiſcriminately preſcribed, to other diſorders it would prove ineffectual; and this method of preſcribing

muſt be too often practiced in diſtempers incident to brutes, who are incapable of deſcribing their ailments, and generally under the care of perſons who have little diſcernment; yet it would be of great uſe, if perſons, who have ſkill and opportunity, would apply themſelves to diſtinguiſh the diſtempers which are peculiar to animals, eſpecially ſuch animals as are profitable to mankind.

The fire which is uſed, in order to raiſe the fumes above-mentioned, ſhould be of very clear charcoal, placed in a chaffing-diſh, into which ſome adviſe to put a piece of iron, in order to abſorb and keep down the noxious ſulphur of the coal, and alſo to move the chaffing-diſh from one part of the room to another, that it may be equally fumigated, and not let ſtay over-long in the room. However, the inconvenience and trouble of the fire might, as I think, be eaſily avoided, when gumms or other things are uſed, which require to have their fume raiſed by heat. For a funnel, about half a yard long, may be fitted into the air-hole on the outſide of the room; in the under part of this funnel, near to the air-hole, ſhould be made a hole, ſome-

what leſs than the mouth of an earthen pot, which holds the fumigating materials, this pot being placed on a chaffing-diſh of coals, and its mouth brought up cloſe to the hole in the funnel, will ſend the fume up into it, which the air, entering by the funnel's mouth, will drive it into the room, and the offenſive ſteam of the coal will be thus avoided. It may be convenient to let the funnel incline a little, that the fume may the eaſier aſcend into the room. This method ſuppoſes the room to be contrived in ſome of the manners above deſcribed, for the admiſſion of freſh air, and letting out the foul, becauſe the fume ſhould come in by the apperture which admits freſh air.

When ſilkworms become ſick and languiſh by a continuance of moiſt weather, it is difficult to relieve them, it being as yet a deſideratum among inventions, to ſupply quantities of dry air from a moiſt atmoſphere. Fires may indeed warm the air, and ſo hinder the bad effect of its coldneſs; but ſtill the air which is conſtantly drawn into a room where there is a fire muſt be ſupplied by the atmoſphere, and bring its moiſture along with it. It is beſt in this caſe to admit no more external air than

than is neceſſary to keep that within freſh. It may alſo be of uſe, before you feed the worms, to ſtrow over them ſome very dry chaff, ſtraw, or hay, ſo thin that they can come through it, and upon this to ſtrow their leaves, this may imbibe part of the moiſture which is in their litter, or on the ſurface of their bodies, and at leaſt it will keep them from lying upon their litter; on which account it may be uſed alſo at other times, when there is a good deal of litter on the hurdles, and you have not leiſure to clean them immediately. Silkworms ſometimes die during their ſpinning, or after they have finiſhed their pods, before they change into a chryſalis. The proper regulation of heat, cold, and freſh air in this caſe is all that is in your power by way of prevention, and this has been mentioned in its proper place. When the worm dies before it has finiſhed its pod, it never feels looſe in it upon ſhaking the pod; therefore ſuch pods muſt never be choſen for breed, nor indeed ought the pods to be taken from the branches till the chryſalis ſhakes in them.

Such diſeaſes of the moths as are within your reach, are only languidneſs in coupling

or laying their eggs, occaſioned by the coldneſs or moiſture of the weather, which indicates warmth and a dry place as the proper cure.

Plate II.

Fig. III.

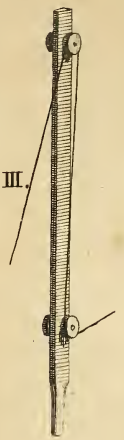


Fig. II.

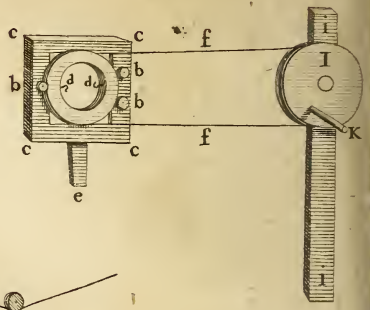
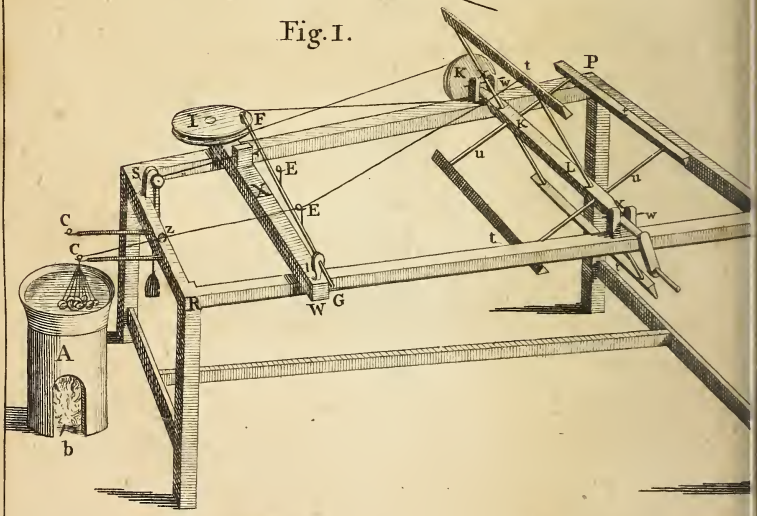


Fig. IV.

Fig. I.



THE
Culture of SILK.
PART IV.

CHAP. I.

The nature of the ſilk-thread as ſpun by the worm. A general idea of the manner of reeling it.

THE three foregoing parts of this treatiſe have only taught how to obtain the ſilkpods in that form which the worm ſpins them; and theſe pods are now no further advanced toward being woven into the various ſtuffs which ſilk can compoſe, than flax or wool are before they are ſpun into yarn.

But the firſt operation that takes place in the ſilkpods is not like that of either flax or wool; each ſilkpod is two continued gloſſy

gloſſy threads, without breach from beginning to end, yet ſo glued together by their natural gum, that to the naked eye they appear but as one thread, in fineneſs equal to the ſmalleſt hair; were this thread to undergo the operation of carding or combing, its ſmooth uninterrupted ſurface would be deſtroyed, it would be reduced to a maſs of broken and entangled fibres, fit only to be ſpun in the ſame tedious manner as flax or wool, and incapable of making ſtuffs with that fine gloſs for which nature extended it to a thouſand foot length.

Yet, to reel off each ſilkpod ſeparately, would be of no uſe, as the fineneſs of the thread would then be inſufficient for manufactures; it is therefore contrived that a number ſhould be joined and reeled at once out of warm water, which ſoftening their natural gum, makes them ſtick together, ſo as to form one ſtrong ſmooth thread.

This thread however is not formed by joining a certain number of ſilkpods, and ſo winding them all off till their threads ended, for by this method the thread which is formed of them all together could not exceed a certain length, and by theſe means

a new

a new ſet of pods muſt be choſen, and a new thread begun ſo often as would greatly interrupt the work; beſides, the thread would continually leſſen in thickneſs as the ſingle threads of the ſilkpods do, and by the breaking of ſome, and by others ending before the reſt, there would be a waſte of what remained. They contrive therefore to be continually adding the ſingle threads of freſh pods as often as others end or break, by which method the thread is continued to what length they pleaſe. The ſingle threads of the new added pods are not joined by any tie, but only ſimply laid on the main thread, to which they adhere by their gum, and their ends are ſo fine, as not to occaſion the leaſt perceptible unevenneſs in the place where they are laid on.

For your eaſier conception, I here give a general ſketch of the manner in which the pods are reeled. Firſt, the pods are cleared of their ſoft outward floſs, and a handful or two of them are thrown into a ſmall kettle of water, under which is a fire to keep it hot. The ends of the threads are found by ſtirring the balls with a ſmall beſom made of fine heath; then, accord-

ing to the intended thickneſs of the thread, a number of theſe ends are taken and paſſed together through a ſmall loop of wire, which projects over the kettle, and hinders the reel from pulling away the pods; the thread is then paſſed through a wire-loop in a ſtick which is called the guide; this ſtick, by a contrivance which ſhall be deſcribed hereafter, moves perpetually forward and backward, ſo as to hinder the thread from ever falling on the ſame part of the reel, by which means the ſeveral rounds would be glued together, and could never be winded off again. From this guide-wire the thread is paſſed, and made faſt to the reel, which is turned by one perſon, while another, ſitting by the kettle which contains the ſilkpods, perpetually ſupplies freſh ends according as they break, wind off, or grow ſmall. The principal perfections of ſilk when reeled off are; that the thread ſhould be ſmooth, of equal thickneſs and ſtrength, not flat, but of a round form, having the ſmall threads of which it is compoſed as equally ſtretched as can be attained, and as firmly united; and laſtly, that the ſeveral rounds as they lie on the reel ſhould not be glued together.

together. The methods by which these qualities may best be attained, will be further taught in the more particular description of the instruments and manner of reeling the silk; and it should always be remembered, that this is a part well worth attending to, as the value of the silk may be greatly raised, according to the perfection in which it is reeled.

CHAP. II.

Of the furnace, reel, and instruments for winding the silk from the pods.

I Shall here describe the several parts of the instruments which are used in reeling the silk off the pods, according to that order in which the silk-thread is conducted from the pods in the cauldron to the reel.

The furnace marked A. Plate 2. Fig. I. is either a little round building, or an earthen vessel about a foot and an half in height, and a foot and an half diameter in the clear; it has a small opening b. in its lower part to receive the fuel, and a funnel in its upper opposite side to let out the smoak.

ſmoak. A thin copper cauldron of the ſame breadth with the clear of the furnace, and about four or five inches in depth, is fixed upon its upper part: this contains the water in which the pods are winded off, its ſhape may be oval, the better to contain two parcels of pods.

The ends of as many pods as are thought proper, being united, are paſſed through a loop of wire. c. which I ſhall call the ſtop-wire, fixed in the end of a rod which projects about a foot from the bench of the reel. Its uſe is to ſtop the pods, and hinder their being drawn farther towards the reel; and this wire projecting over the copper, cauſes any of the pods which chance to leap out of the water to fall directly down again. It is uſually made by giving the wire a turn like one round of a bottle-ſcrew, making the end come a little acroſs. By this method the ſilk-thread eaſily ſlides into the loop, which, if inſtead of this contrivance it were a ring, would give trouble in paſſing the thread through; this wire is fixed into the end of a ſmall ſtick, which ſhould project about a foot from the front of the ſtand. P. Q. R. S. which ſupports the reel and the loop

ſhould

ſhould be about a foot or more diſtant from the ſurface of the water, and ſhould be made of braſs wire, as ſhould every loop through which the ſilk paſſes; for iron wire, though mentioned by moſt writers, when it takes ruſt, becomes a ſort of file, and would fret and break the thread; but braſs wire doth not take ruſt by being wetted.

From the ſtop-wire C. the ſilk-thread was formerly conducted over a ſmall pully faſtened to a piece of wood about three inches high, which ſtood in the front of the reel's bench directly over the rod, which holds the ſtop-wire. The intention of this little pully, or bobbin, was to preſs the moiſture out of the ſilk-thread before it came to the reel, but a better contrivance has been ſubſtituted for it.

From this pully the ſilk-thread paſſes through a loop of wire E. which I call the guide-wire; this loop is formed in the ſame manner as the loop of the ſtop-wire before deſcribed; the wire is fixed in a ſmall ſtick F. G. called the guide-ſtick, the uſe of it being to guide and ſpread the thread E. t. in ſuch a manner on the reel, that it may not always fall in the ſame

place,

place, ſince this would ſo glue the moiſt thread together, that it could not afterwards be ſeparated.

The guide-ſtick receives its motion from a wheel marked I. which formerly turned on a pin fixed in the ſide of the reel's bench, but that ſituation is now changed; its diameter is from eight to ten inches, according to the ſize of the reel you uſe; it has holes nearer or farther from its center to ſhift the pin which goes into the guide-ſtick, and ſo ſpread the ſilk leſs or more upon the reel. This is a round pin, and is received into a round hole in the end of the guide-ſtick F. ſo looſe, as to allow the wheel to turn freely. It is turned by means of a band which paſſes over another wheel K. fixed to the axle of the reel. The beſt proportion of this wheel K. to the guide wheel I. for diſtributing the thread on the reel, is as twenty two and an half to thirty ſeven. The wheel I. being put in motion by the turning of the reel, doth in each revolution make the guide-ſtick F. G. go and return, its end G. being round and ſliding forward and backward in a hole which is made in a piece of wood L. The pin on which the guide-ſtick moves muſt

be

be made with a little collar, ſo as the guide-ſtick may not lie cloſe to the ſurface of the wheel I. leſt in its motion it ſhould ſtrike againſt the axle or pin, upon which the wheel turns. From the guide-wire the ſilk-thread is drawn to one of the bars of the reel I. and there made faſt in order to be reeled.

The reel is compoſed of an axle, H. which is beſt made ſquare for the advantage of boreing it true, in order to let in the croſs ſtick, u. u. *&c.* which are to ſupport the four bars, t. t. t. t. for this purpoſe it is bored within half a foot of each extreme, with two round holes pretty near, and at right angles to each other. The axle may be about two inches ſquare, and the holes about an inch diameter, into which the croſs ſupporters u. u. *&c.* muſt fit tight at their middle part, though they may taper to half an inch diameter at their ends. Theſe ends fit tight into holes made in the four bars, t. t. t. t. the croſs ſupporters muſt be of ſuch a length, as to make the four bars t. t. t. t. ſtand two or more feet diſtant from each other, making the round of the reel about eight feet.

The

The four bars have been generally made round, but I would recommend, as a better method, to form them firſt rectangular, about one inch by two, and then to plane down the edge, which is to be the outermoſt and receive the ſilk, to any angle leſs than a right angle; for being placed thus edgeways on the croſs ſupporters, they will reſiſt the ſpring of the ſilk as joiſts do the weight of a floor; for one could ſcarce imagine, if he had not tryed it, how great a power a thick ſkain of ſilk has to warp and bend the bars of the reel. Another advantage of planeing their outer edge down to leſs than a right angle, is, that in this caſe the ſilk will only touch the bars in a point, whereas if they were round, it would lie upon one half of the circumference of each bar, which would cauſe a good part of the ſkain to be flat, and the threads to be more glued together in the four different parts which lay upon the four bars. The angle however ſhould not be left ſharp and cutting, but ſhould have its edge a little rounded. And the bars ſhould be made of wood which is pretty hard and ſmoothly poliſhed, for if it has any ſplits, or roughneſs, the threads

of

of the ſkain will be apt to catch and break when you are diſbanding it from the reel.

The axle of the reel turns in two grooves, made in two pieces of wood x. x. fixed in two oppoſite ſides of the bench, by means of the wince or handle, L. the axle is rounded and reduced to about an inch and an half diameter, at the parts which lie in the grooves; in which it is kept by two wire pins, w. w. one of which ſinks a little into a ſmall groove turned in the axle itſelf, by which means it is kept very ſteady, or it may be kept ſteady by two ſhoulders, if they are exactly at the diſtance of the two pieces of wood which ſupport the axle.

In this deſcription of the reel I have, for brevity's ſake, only mentioned one ſilk-thread; but as two may be reeled at once upon different parts of the reel according to the expertneſs of the ſpinner, which is the perſon who ſupplies freſh ends when any of the pods break, or are winded off, therefore you are to ſuppoſe the other thread conducted in the ſame manner, as that already deſcribed thro' the other ſtop-wire, C, *&c.* at about ſix inches diſtance from

from the other, in the manner which you ſee delineated in the figure.

The foregoing deſcriptions mentions the manner in which the ſilk-reel is at preſent made and uſed, but the plate which repreſents it ſhows it with the new improvements made lately by Mr. *Vaucanſon*, and deſcribed in the memoirs of the academy of ſciences at *Paris*, but without giving any figures of the deſcription. The reaſon and foundation of theſe improvements are conſidered more particularly in the following chapter.

CHAP. III.

The improvements of the ſilk-reel, and the manner of reeling.

WITH regard to the motion of the guide-ſtick, Mr. *Vaucanſon* obſerves that it was found that the band which paſſes over the two little wheels K. I. by being variouſly ſtretched by the weather, inequalities of the wheels, *&c.* could not make the guide-ſtick F. G. move in ſo uniform a manner as always to diſpoſe the different

different revolutions of the thread upon the ſame parts of the reel. And therefore it was contrived that the guide-ſtick ſhould be moved by a ſet of three or four wheels with teeth, or cogs communicating with that on the axle of the reel. But theſe being made of wood, and frequently breaking, and going out of order, occaſioned delay and loſs in the reeling of the ſilk; he therefore revives the method of working by the band, and to keep it always at the ſame degree of extenſion; contrives that the wheel I. which moves the guide-ſtick ſhould turn upon an axle, which is fixed in one end of a bar of wood, W X, this bar is moveable on a pin. y. paſſing through a hole in its other end, (the lower part of that piece of wood through which the guide-ſtick goes and returns may ſerve for this purpoſe) then the end W. on which the guide-wheel turns is drawn by a ſtring paſſing over a pully near S, to which a weight of one or two pounds is faſtened. And thus the band is kept conſtanly at the ſame ſtretch.

The next defect was found in the ſmall pullies, or bobins, whoſe uſe as mentioned in the foregoing chapter, was to ſqueeze

ſome of the moiſture out of the thread as it paſſed over them. This however, they did but very imperfectly, and were beſides found by their preſſure to give the thread a flat form, whereas its perfection is to be as round as poſſible. In ſtead therefore of theſe pullies, they contrived to make the two threads croſs by twiſting three or four times round each other, between their paſſage from the ſtop-wiresto the guide-wires, which they called winding in croſs. This method had great ſucceſs; the threads by being thus wrapped two or three times round one another became round and compact. And the preſſure made by the croſſing one another, added to the frequent vibrations which were made at the angle, where the two threads ſeparate in winding, cauſed them to arrive at the reel well drained of their moiſture, and of a more round form.

Mr. *Vaucanſon* obſerves on this method, that the threads are made to croſs by twiſting them over one another with their fingers, which have no accurate ſenſe of feeling, by being continually employed in the warm water; and that by theſe means the

the degree of croſſing is not accurately determined. He adviſes to encreaſe it by making a double croſſing, and deſcribes a method both of doing this and determining the degree, or number of the times, that the threads are croſſed, in the following manner.

A wooden ring marked A. Plate II. Fig. II. is made three quarters of an inch in thickneſs, and one inch broad, its inner diameter is ſix inches and an half. Its outſide rim has a groove for the reception of a band, f. f. this ring is placed between three little wooden rollers b. b. b. which turn on pins fixed in a ſquare frame of wood, c. c. c. c. the frame is fixed by the pin e. which comes from its lower ſide into a hole, Z. which is bored in the middle between S and R in the reel's bench, Fig. I. the band which goes in the groove of this ring goes alſo round a groove in a wheel I. of the ſame ſize, which turns on a pin going thro' its center into an upright, i. i. which is faſtened in a hole to ſuch a part of the reel's bench, R. where it can moſt conveniently be reached by the hand of the ſpinner, who ſits by the cauldron,

and turns it by a little handle k. when when the threads are to be croſſed.

Now the two ſilk-threads after having been paſſed thro' the loops of the ſtop-wires, c. c. inſtead of going over the bobins, or pullies, are made to paſs over two little hooks of braſs wire, d. d. placed oppoſite to each other on the inſide of this wooden ring. From whence they go each thro' its own guide-wire, and ſo to the reel.

And now, by giving the wheel I. over which the band paſſes two, three, or more turns; the wooden ring, over which the ſame band paſſes, is turned the ſame number of times, and ſo many times are the ſilk-threads croſſed over one another, and that in two places, *viz.* before they arrive at the wooden ring, and after they paſs thro' it. By this double croſſing, or twiſting over each other, the ſilk-threads in reeling, are as it were, wrung and ſqueeſed; and the gummy moiſture, which they receiv'd in the kettle, drained and preſſed out, ſo that they arrive at the reel much dryer than they otherwiſe would do; and from the preſſure which they undergo at the croſſings are made more firm, compact, and

and round; ſo as to appear in ſome meaſure twiſted.

Mr. *Vaucanſon* mentions a further uſe of winding in the croſs: which is that it ſhews on which ſide the ſpinner ought to add freſh ſilk-pods in order to keep the two threads of equal ſtrength and thickneſs: he juſtly obſerves that keeping always the ſame number of ſilk-pods will not preſerve the ſame thickneſs in the thread; for the ſingle thread of one pod that is but a little winded off, may be as thick and ſtrong as two, three, or more that are almoſt exhauſted; but the croſs which is next to the ſtop-wire will, as ſoon as either thread grows weaker than the other, ſwerve towards the ſide of the ſtronger thread, and thus give notice that ſome ſilk-pods are to be added to the other ſide.

But I muſt obſerve that this ſwerving of the croſs, to either ſide, will not happen unleſs the hooks of the wooden ring, over which the threads paſs be kept in a poſition horizontal, and alſo each hook on the ſame ſide with that ſtop-wire from which its own thread proceeds; and, tho' Mr. *Vaucanſon* mentions this as a method of keeping each thread to the ſame thickneſs

with which it began, it will only keep them of the ſame thickneſs with one another in correſponding parts. For the addition of pods on one ſide or the other, in order to bring the croſs to the middle, may happen to be ſuperadded ſo equally, that, tho' the threads equal one another, yet at long run you ſhall either add more thickneſs to each thread than you ſet out with, or fall ſhort of it; ſome regard muſt therefore be had to the number of ſilk-pods with which the threads were begun, ſo as not conſiderably to encreaſe or leſſen their number.

Mr. *Vaucanſon* obſerves that when the croſs ſwerves much to the ſide of the weaker thread, and remains long in that ſituation, the thread is then apt to break; he therefore ſometimes made the croſs ſtand between the fangs of a ſmall fork, that young beginners, who were not expert at reeling in croſs, might have time to add freſh pods to the weaker thread, the fork confining the croſs ſo as not to let it ſwerve much.

Thus I have given the ſcope of Mr. *Vaucanſon*'s improvement of the double croſſing, and the advantages he propoſes from it.

it. He ſays indeed, that the women who reel the pods will with difficulty be brought to uſe it, becauſe the threads thus croſſing twice are liable to be broken, and occaſion delay, eſpecially if they are not kept clear of any floſs, or burr, which is apt to riſe either from the pods not being at firſt well clear'd of the floſs, or from the water being too hot. Mr. *Vaucanſon* therefore propoſes this double croſſing chiefly for ſuch ſilk as is to ſerve for warp; which, becauſe it ſuffers a conſiderable ſtreſs in the operation of weaving, is therefore to be made more compact and ſtrong.

It may be obſerved that the apparatus of the wooden ring is only for the readineſs of croſſing the two threads, for they may receive a double croſſing by means of two little hooks plac'd at each extreme of a ſtick ſix inches long, and fixed in its middle point upon another, ſo as to form the figure of a T. this being placed erect in the place of the wooden ring, the two threads which paſs parallel over its hooks will receive the double croſſing, by taking off the top of the T. which is only faſtened by a hole in its middle; and, after it

has been turned round ſo many times as is neceſſary for the croſſing, replacing it.

I mention this becauſe it requires little apparatus; the double croſſing may firſt be tried in this manner, and, if it comes into practice, Mr. *Vaucanſon*'s method may afterwards be uſed. The chief advantage of two croſſings are the ſtarts and vibrations which the two threads undergo when they ſeparate at the croſſes; this makes them ſhake of the moiſture with which they are loaded, more ſpeedly, as the vibrations are double of what they would be with only one croſſing.

Some dimenſions of the reel, *&c.* which are as yet undeſcribed, are as follows. See Plate II. Fig. I.

The length of its bench, P. S. about five foot.

Its breadth S R. two foot and a half.

The feet at S and R next the cauldron, two foot high.

Thoſe at P. and Q. next the reel, two foot and a half high.

The ſtop-wires fixed in the two rods C C. project one foot from the tranſverſe, S R. and are about ſix inches aſunder, *viz.* equal to the diameter of the guide-wheel

I. and about a foot diſtant from the cauldron.

The bar M N. which ſupports the guide-wheel I. and guide-ſtick E. G. is two foot diſtant from the end C. of the ſtop-wires, the guide-wires are ſo long as not to let the ſilk-thread make an angle at the m.

The axle of the reel K L. is three foot diſtant from the guide-ſtick.

The reel's diameter, *viz.* the length of the croſs-bars about two foot for fine warp, for woof it is often four or five foot; but this is not reel'd in croſs.

The guide-wires, E. E. are at the ſame diſtance from each other as the ſtop-wires, *viz.* about ſix inches.

The diameter of the guide-wheel's groove is to the diameter of the ſmall wheel's groove, as 74, to 45; for ranging the ſilk in the beſt manner on the reel; the ſize of theſe wheels ſhould enlarge with the reel's diameter, but the proportions ſhould be kept. The bench muſt alſo be lengthened when the reel is made large.

The Furnace A. is round, or oval, with a fire hole, B. and it would alſo be the better of a flue to carry of the ſmoak.

The

The copper or cauldron is ſhaped to the form of the furnace; (the oval form is beſt for reeling two or three parcels of of pods) it is about four or five inches deep; it may ſink into the furnace, and be ſupported by its ledge; or it may be only a pan ſtanding on the top of the furnace, in which caſe the furnace muſt not be much above a foot high.

Though the fore feet of the reel's bench are by authors directed to be made only two foot high, and the hinder ones two foot and an half; yet it would anſwer better if they were made higher; for then the ſtop-wires C. C. would be raiſed ſomewhat more above the cauldron, which would give better ſcope to the adding of freſh ſilk-pods by having more length of threads beneath the ſtop-wires, for it is theſe ſeparated threads that catch the freſh ones which are added and carry them up. Beſides, the pods in the cauldron would not then be ſo apt to riſe and ſtrike againſt the ſtop-wires, which often breaks ſome of the threads. The feet therefore ſhould be ſo high, as that the ſtop-wires may be at leaſt a foot and half above the water in the cauldron, and the cauldron itſelf not

ſo

ſo low as to be uneaſy to the woman who ſupplies ſilk-pods, by making her ſtoop too much, as ſhe ſits by it.

Small models of the reel are made by Mr. *Thomas Belcher*, Cabinet-maker in *Brownlow-ſtreet*, *Holburn*.

CHAP. VI.

How to take of the floſs or looſe ſilk from the pods, the reaſon of ſorting theſe according to their different degree of fineneſs, in order to be reeled.

BEFORE the ſilk-pods can be reel'd, it is neceſſary to free them from that looſe fuzzy ſilk which is on their outſide, and is called the floſs, it being of ſo fine and looſe a conſiſtence, and partly broken by taking it from the branches where the worms had ſpun it, that it cannot be reeled off in water. It may be taken off by opening it on one of the ends of the ſilk-pods, and then thruſting out the hard part of the pod, which is that which is to be reeled, clearing off the looſe ſilk which adhers to it, and throwing this part with the

the floſs, in order to make ordinary cheap ſilk.

And now, at taking off the floſs, is a good time for ſorting the ſilk-pods according to their different degrees of hardneſs; this is a thing which is very little attended to in the countries where ſilk is produced. They careleſly throw into the hot water all kind of ſilk-pods, and ſo reel of the ſtrong and the tender, and often the double ones mixed with them, the conſequence of which is, a great deal more trouble in the reeling, the ſilk breaking much oftener, and being much the worſe.

For the proof of this, let us ſuppoſe only two ſilk-pods, one campact and hard, and the other of a looſe and ſoft ſubſtance thrown together into the hot water, in order to be reeled off together, and to make one thread: if now the water be ſufficiently hot to let the hardeſt of the two ſilk-pods wind off with eaſe, by diſſolving its gummineſs, then that water will be too hot for the other pod whoſe ſubſtance is looſe, ſo that it will run off in burrs, that is flakes of the ſilk will come off without being drawn to their extent, which burrs as they paſs the ſtop-wires, or guide-wires, will

will endanger the breaking of the thread, filling it alſo with lumps and inequalities.

On the other hand, if the water is juſt properly warm for the ſoft pod, ſo as not to occaſion the above inconveniency, it will then not be hot enough for the hard pod, ſo that its thread will not be diſunited from it, without ſome ſtretch and violence endangering its breaking, and giving the trouble of adding a freſh pod. And in both caſes the ſingle hairs of the ſilk-pods, being unequally ſtretched in reeling, will make the combin'd thread the weaker, and alſo leſs even, and gloſſy, ſince the ſingle hair of that pod which was moſt ſtretched by the reel will, upon diſbanding, contract itſelf more than the other, and be ſeparated from it in ſome places.

On theſe accounts, having firſt ſeparated the double pods, and alſo thoſe which contain nothing but floſs, with any others, which, being imperfectly formed, cannot be reeled; ſort the perfect pods into three kinds, and do this at the time that you are ſtripping off the floſs, which being removed, you can readily perceive their different

ferent degrees of hardneſs, and throw them into three different baſkets. The firſt ſort will conſiſt of all that are very compact, having their ſingle hairs very firmly glued over one another; the ſecond of thoſe which are of a middle conſiſtence; and the third, thoſe whoſe hairs are looſe and open. The hard or looſe conſiſtence is not judged of by the floſs, but by the compact part of the pod which remains under the floſs.

It may not be amiſs to obſerve that children may readily be taught the buſineſs of ſtripping the floſs from off the pods, but to judge of their conſiſtence and ſort them, will require a perſon of ſome ſkill; and though the ſtripping off the floſs may be performed by candle light, this time is not very convenient, either for ſorting, or reeling, theſe requiring a good light and a quick eye; though with regard to the compactneſs or ſoftneſs of the pods, you will partly be guided by the feeling, and partly by the appearance, thoſe being the hardeſt, and requiring the water in which they are reeled warmeſt, whoſe hairs appear moſt firmly adhering, and moſt glued over one another. The time ſpent in ſorting will be

be very inconſiderable with reſpect both to the time and labour which it will ſave in the reeling, and with reſpect to the advantage and value which the ſilk will receive from it; for which reaſon, I do the more earneſtly recommend it as a work which is both eaſy and of great importance.

CHAP. VII.

How to reel the ſilk from the pods.

THE kind of water in which the ſilk-pods are reel'd is of conſiderable importance, water which is called hard; ſuch as that of ſprings and wells, is by no means to be uſed, for it will not diſſolve the gumminеſs of the pods, ſo that they will wind off with difficulty, and their threads be liable to break often. Chooſe therefore the ſofteſt water from ſlow running rivers, or ponds, and which has been longeſt expoſed to the air. This water being put in the cauldron of the furnace before deſcribed, let it be made juſt to ſimmer, or come to boiling, and then, with a

ſkimming diſh, take off any ſcum which riſes on the top.

For the hardeſt ſort of pods a ſcalding heat will be neceſſary, but a leſs degree for the others. However, the heat cannot be aſcertained till you begin to reel, for then, if the ſilk comes off in burrs, or lumps not ſtretched to their extent, the water is too hot, and the fire muſt be abated under it. On the contrary if the ſilk comes off with difficulty, which is known by the pods often leaping out of the water, it is then too cool, and the fire muſt be increaſed.

The ſpinner, which is ſhe who attends the management of the ſilk-pods in the cauldron, muſt be provided with a bruſh made of the fineſt twigs, or tops of heath bound together, and cut off flat at the bruſh part. Then being ſeated before the cauldron, ſhe throws into it an handful or two of the ſilk-pods, of one ſort or degree of firmneſs, and preſſing them gently under water with the flat bruſh, the ends of the ſilk-pods will adhere to the twigs: ſhe then takes as many of theſe ends as are neceſſary, according to the thickneſs ſhe intends her thread, and, bringing them together,

gether, draws out the united thread until ſhe finds that the ſingle hairs of which it is compoſed come off eaſy and free from floſs. She then breaks off ſo much of the end of the thread as came of coarſe with floſs, or burrs in it; and, throwing it aſide, delivers the end of the perfect thread to the perſon who ſtands ready to turn the reel, who immediately paſſes it through the ſtop-wire, and through its guide-wire, and then makes it faſt to the reel, as mentioned in the deſcription of the reel. In the mean time the ſpinner has another thread prepared for him, which he paſſes through the other ſtop-wire, *&c.* in the ſame manner; and if the ſilk is to be reel'd in the croſs, you are to underſtand its being paſſed over the croſſing-wires.

And now, both threads being faſtened to the reel, it is turned with a regular even motion, at firſt ſomewhat leiſurely, till the threads are found to run free and eaſy, for it will happen that ſome of the ends which were taken to compoſe the thread were falſe ones, becauſe in taking off the floſs, there may be two or three breaches made in the beginning of the hairs, which in winding will ſoon end, and muſt be added anew to make up the number

which you deſign in the thread. It might therefore be convenient in the beginning of the thread to put a few more pods than you intended to continue, which will ſoon be reduced to the proper number.

As ſoon as the pods begin to give the thread freely, the reel is turned with a quicker motion, and the ſame thing which, as I mentioned before, regulates the heat of the water, will alſo regulate the motion of the reel; for if the pods leap up often, and beat againſt the ſtop-wire, the motion of the real muſt be ſlackened, and if the thread comes off in burrs, it muſt be turned quicker. And of this the ſpinner, who has her eye upon the balls and thread, muſt, as ſhe ſees occaſion, apprize the reeler; and at the ſame time the fire muſt be increaſed or diminiſhed, that the reel may be allowed a proper motion, which ought to be as quick as may be, without endangering the breaking of the thread, or hurrying the ſpinner, ſo that ſhe cannot add freſh pods as faſt as the old ones are ended.

While the reel is turning, the ſpinner is continually adding freſh pods to each thread as faſt as ſhe can find the ends, not waiting till ſome of the number ſhe began

gan with are ended; but being before hand, and at any leiſure intervals, preparing freſh ends by dipping the heath bruſh among freſh pods, of which ſuch a quantity muſt be conſtantly thrown into the cauldron as will ſuffice to ſupply the two threads which are reeling, but not more, leaſt, by being too long ſoaked in the hot water, they ſhould wind off in burrs; and theſe pods which are thrown into the cauldron, muſt be often forced under water, that they may be equally ſoaked; for, as they ſwim with their greater part above water, that part would remain hard and ſtubborn, while the part which is under water would be too much ſoaked: or otherways you may with a bruſh frequently throw ſome of the hot water upon them, as you may likewiſe do on the pods which are reeling, when you obſerve them grow dry at top, and yield the thread ſtubbornly.

The ſupplying of freſh ends is performed by laying them ſlopingly acroſs the ſingle ſilk hairs which continue ſeparate till they reach the ſtop-wires, for here the added one is readily caught by them and drawn up; for which reaſon the ſtop-wire ſhould be about a foot above the water.

There is a readineſs in adding freſh pods which can only be acquired by practice, in which ſome are ſo expert, that they can ſupply three threads of ſilk paſſing thro' three different ſtop-wires.

You will know when any pods are compleatly winded off, when you ſee the ſmall remainder of the pod riſe out of the water, and ſtick at the loop of the ſtop-wire; the worm having then droped out, the remaining ſilk becomes too light to remain in the water. You will know when the ends of any pods break before they are winded off by their remaining at reſt in the water, and generally by their quitting the company of the reſt, and lying cloſe to the ſide of the cauldron. When the ſpent pods leap up and adhere to the loop of the ſtop-wire, they muſt immediately be taken away, elſe by choaking up the paſſage, they will endanger the breaking of the whole thread.

The quantity of ſilk which can be reeled in any given time is, cæteris paribus, in proportion to the quickneſs with which the ſpinner can add freſh ends. Thus if you ſuppoſe that every ſilk-pod, at a medium, will either break or be winded off at the end of five hundred foot, then, if

five

five ſuch pods are reeled together, a freſh end will be wanted at every hundred foot that are reeled; if ten are reeled together, one will be wanted at every fifty foot; if ſixteen together, then at thirty one foot, and ſo on. Nor doth it make any difference whether twenty pods form only one thread, or whether they are divided ſo that each five forms a diſtinct thread, in both caſes, if they are reeled at once upon the ſame reel, they will require nearly the ſame diſpatch to ſupply freſh ends; and this points out a method of employing ſpinners according to their different ſkill, for if one ſpinner can ſupply two threads each of ten pods, then another ſpinner who can ſupply ends only half ſo faſt, can only attend two threads each of five pods, or one of ten pods.

The ſeldomer that pods end or break, the greater number of them can one ſpinner attend, which ſhews the advantage of large and ſound pods, and of every artifice which can hinder either the breaking of the ſingle hairs, or of the whole thread.

The breaking of the ſingle hairs is principally owing, either to bad ſilk-pods, *viz.* being ill formed, as they will be when the

worms were disturbed and interrupted during their spinning, either by shaking, or by cold weather rendering them torpid and inactive at their work, a thing at that time very manifest to the sight. Or the single hairs may break by an improper regulation of the heat in the water, when it is not sufficient to make them wind off easy; or when it is too great, and occasions burrs which may stop at some of the wire-loops through which the thread runs; pods also which have two worms inclosed will perpetually break.

The whole thread may also break, by burrs stopping at the wire-loops, or by the reel's being turned by jerks. It need not however be knotted, but may be fastened by laying the parts on one another, and giving them a little twist; or the end which broke may be carried up to the reel and so fixed as readily to find it again, and may be reel'd on without uniting it to the other, for all delay should be avoided. To avoid the breaking occasioned by burrs, the wire-loops should not be too small, but so wide as to let them easily pass, and if the distance between the reel and the pods were increased; the thread then by having length

length would have time to let the burrs ſtretch out, and thus make the thread more even.

I think it would be convenient for the ſpinner to have a little ſtick erected cloſe to the ſide of the cauldron, which having two or three pins in it would ſerve to hang her heath bruſh by means of a little hook at the end of it, and alſo any other little inſtrument which ſhe may want, ſuch as a ſharp fork with which ſhe may draw away the pods which are ſpent, and have dropped the worm; or ſuch as, being near ſpent, have the bag drawn together and ſtick at the ſtop-wire; and as the heath bruſh will frequently take up more ends than are immediately to be added, and as the ſpinner will ſometimes have occaſion to employ both her hands, the bruſh will at that time conveniently hang by the cauldron, while the pods which are attached to it remain in the water, and the ends will be in readineſs as they are wanted; in this caſe the pods which do not reach the water may be drawn down to it between the ſpread fingers of her hand.

If the ſpinner is under a neceſſity of leaving her work for any length of time,

the pods ſhould all be raiſed with a ſkimming-diſh out of the water till her return, otherwiſe by over ſoaking they would wind off in burrs; but it is beſt to continue the reeling without interruption, and to let freſh perſons ſucceed thoſe who are tired. The water however muſt be changed as it grows foul, and ſometimes fetid, from pods where the worms have been killed ſome days before; the chryſalids when the ſilk is reeled off them are uſed to feed hogs or poultry.

The perſon that turns the reel ſhould have an eye to the threads and to the loops of wire through which they paſs, that he may apprize the ſpinner when any thing is wrong, for her eyes will be ſufficiently employed about the pods. The reeler might alſo rectify any thing which goes amiſs in thoſe parts of the thread which are near the reel, for he will always have one hand unemployed, and muſt even ſtop from turning for a little while upon emergency. Though the reeler can change hands as they tire by turning, yet for his eaſe I think he might have a ſupport for his arm oppoſite to the axle of the reel, and ſo to turn the handle only by that motion which

which he can give it by the arm moving upon the elbow as upon a centre.

I muſt obſerve here that the buſineſs of winding the ſilk from the pods is, in ſome countries committed only to perſons who upon examination are found properly qualified, and that the ſeveral regulations which regard the reeling are eſtabliſhed by law, and penalties annexed; but I doubt whether ſtrict regulations would be proper in the infancy of a manufacture of this kind in our colonies, I believe it is better at firſt to encourage all endeavours, and to let regulations grow upon time and experience.

It is neceſſary to inform you here, that as the heat of the water in the cauldron will require to be varied according to the eaſe or difficulty with which the pods give their ſilk, therefore the ſpinner ſhould always have ſome cold water within her reach, in order to cool that in the cauldron quickly, when the ſilk comes off too eaſy and in burrs, and ſome chips or ſhavings ſhould be at hand to augment the heat quickly when the pods are ſtubborn in letting the ſilk wind off. A contrivance indeed might readily be made by which the fire, lying upon a little grate with cloſe

bars, might readily be approach'd to or withdrawn from the bottom of the cauldron, which would more ſuddenly vary the heat. This might be done by making the grate hang on a ſwivel, with a handle coming out of the fire place by which it might be raiſed or depreſſed.

It would be convenient alſo to have a tap-hole in the ſide of the cauldron, at its bottom, for emptying the water, when it grows foul and fetid from the chyſalids which ſoon corrupt it, and, as they ſink to the bottom, cannot eaſily be taken away without drawing off the water, which beſides its offenſive ſmell doth, by its foulneſs, diminiſh the luſtre of the ſilk.

CHAP. IX.

Some further hints for the improvement of reeling the ſilk from the pods.

I AM inclined to think that a method might be contrived, for reeling ſilk from the pods, nearly as advantageous as winding in the croſs, and ſubject to fewer inconveniencies.

Mr.

Mr. *Vaucanſon* ſays, that ſilk reeled in the croſs has an appearance as if it were twiſted; that this can be no more than an appearance I think requires little proof, for the end of the ſilk-thread at the reel and at the pods may be ſuppoſed fixed, and therefore any twiſt which is given at the place of croſſing, goes off as ſoon as that part of the thread has paſſed the croſſing; it can no more remain than if one ſhould faſten any ſtretched thread at its two extremes, and then twiſt it in the middle between the finger and thumb, as ſoon as thoſe are withdrawn the thread untwiſts.

The real advantages of croſſing are the wringing out the ſuperfluous moiſture, and the compreſſion of the thread, whereby it is rendered more compact: the inconvenience attending this method is the frequent breaking to which croſs'd threads are ſubject. I leave it to experience to determine whether the following method will not procure advantages nearly equal to thoſe which ariſe from winding in the croſs without its diſadvantages.

Let a ſlender ſquare pole of about three or four foot long be fixed perpendicular in the

the forepart of the reel's frame, juſt between the two ſtop-wires. At the top of the pole let an ivory pully of about one inch diameter turn upon a ſmooth wire-pin fixed in the ſide of the pole; and let another pully of the ſame kind be placed in the ſame ſituation near the bottom of the pole. Theſe pullies ſhould have a groove formed to the angle of an equilateral triangle and ſmoothly poliſhed; they ſhould alſo be formed with a little round navel at their center to keep their flat from rubbing againſt the pole. The pole ſtands in a round hole, and can be drawn out as occaſion requires, or turn'd awry. See Plate II. Fig. III.

Now when the ſilk-pods are to be reeled, the thread after having paſſed the ſtop-wire is conducted over the upper pully, then under the lower one, from hence to the guide-wire and then to the reel. By this method the length of the thread from the cauldron to the reel may be increaſed to what degree you think proper, *viz.* either by having a longer pole, or by having two pullies above and two below, and ſo making the thread paſs up and down over them. By theſe means it may have fifteen or twenty foot ſpace to run thro', and

ſhake

ſhake off its ſuperfluous moiſture, which will be further promoted by the preſſure which it ſuffers in paſſing over each pully; this preſſure will at the ſame time help to make it compact; and the groove of the pullies being the angle of an equilateral triangle will throw it into a figure which by the time it arrives at the reel will be ſufficiently round: yet this roundneſs is not only to the grooves moulding the thread into a compact figure, but to a cauſe leſs apparent which is this: the plane of the pully ſhould not be exactly parallel to that of the thread by which means the thread will always roll a little on the ſide of the groove, and ſo will receive a ſmall twiſt as it approaches to, and as it leaves each pully.

That this theory is alſo true in fact, you may eaſily prove by ſtretching an untwiſted ſilk-thread on two pins; if you then roll one of the above-mentioned pullies along it, holding its axle between your finger and thumb, you will perceive that any ſmall particle of down, which you may faſten to the thread, will begin to turn round as the pully draws near it, provided you give the pully a very ſmall in-

inclination, and do not keep its plane exactly parallel to the thread.

The ſmall twiſt which the thread ſuffers as it approaches the pully has this further uſe, that it ſecures the ends of the freſh pods which are continually added, from the hazard of ſticking to the pully, and ſo of being ſtripped from the main thread and winded round the pully; and this will be more effectually prevented if the thread is made firſt to paſs over, and bear a little upon a ſmall wire hook placed within an inch or ſo of the upper pully; for then the whole twiſt will be confined to that part which lies between the hook and pully, and will thus ſecure the end juſt where there is a neceſſity: but without this hook the twiſt would be ſpent over the whole length of thread which lies between the pully and the ſtop-wire, ſo that it would be but very little in any one part of that length. However, there will be no occaſion for the hook unleſs it is found by experience, that the end is apt to catch and ſtick to the pully, which in my tryals I have not found.

I mentioned before that the groove of the pully ſhould be very ſmooth, by which I chiefly mean the very edge of the angle where

where the thread reſts; I don't know whether there can be a better method of effecting this, than, after the angle of the groove is formed in the turning-lath, to uſe a piece of the fineſt ſteel-wire, as ſmall as a hair, ſtretched on a bow, which being held againſt the angle of the groove, while the lath turns the pully, may take off any roughneſs, and alſo make the edge of the angle, inſtead of being quite ſharp, ſomewhat approach to a circular form, which may be of uſe to the thread that runs in it, which from pullies thus regulated will at leaſt not receive that flat form which it did in the old method of reeling over the bobins.

CHAP. X.

Of diſbanding the ſilk from the reel, and tyeing it up in ſkains: the uſe of the floſs-ſilk.

WHEN a ſufficient quantity of ſilk is on the reel and you intend to to take it off, there ſhould ſeem to be no great room for much inſtruction. Yet here I ſhall take occaſion to mention ſome

things which will be found uſeful, even in this buſineſs.

One cannot conſider attentively the manner in which the ſilk is reeled from the pods, without obſerving that the ſingle ſilk-hairs of which the thread is compoſed, are liable to ſuffer very different degrees of ſtretching as they are winded from the pods. If the balls are not ſorted well, this different degree of extenſion will be the greater, and, even when they are ſorted, they muſt ſtill be ſubject to different ſtretching, becauſe ſome are a little longer in the water than others and therefore give their ſilk eaſier; and alſo becauſe the weak latter end of ſome pods wind off with the ſtrong firſt part of others.

The hairs being thus ſtretched unequally, will occaſion (when the ſkain is taken from the reel too ſuddenly) thoſe hairs which are moſt ſtretched to contract more than the others, by which their union will be in ſome meaſure deſtroyed, and the thread compoſed of them rendered leſs compact and firm, the ſingle hairs appearing in ſeveral places disjoined from one another.

To remedy this the ſkain ſhould not be ſuddenly taken from the reel, but remain there till the unequal extention which it ſuffered in winding is by the ſtretch which it undergoes on the reel brought nearer to an equality, and till the thread by being well dried has its hairs firmly united. This would be beſt effected by having two reels, and when one was filled they might immediately proceed to wind upon the other. That which has the ſkains being taken off its frame ſhould ſtand in the ſun, or at a moderate diſtance from a fire till the other is filled with ſilk, and this is again wanted. This would alſo prevent delay as the ſkain might be taken off, and the reel made ready by a perſon not employed in the reeling. When the ſkain is finiſhed there ſhould ſome mark be tied to the end of the thread, otherwiſe it may be difficult to find it, if it mixes among the threads of the ſkain.

When the ſkain is quite dry, and you proceed to diſband it from the reel, you muſt firſt ſqueeze it together all round, by which it will become looſe upon the bars, becauſe its threads were all laid obliquely on by the guide-ſtick; then, with a piece of

twine made of the refuſe ſilk, make a tie juſt on that place where it bore upon the bars of the reel: then ſlide it off the reel, and make another tie on the part oppoſite to that where you made the firſt; after which you muſt double it, and tie it round near each extremity, and then it may be laid up for uſe or ſale.

As to the floſs ſilk which was on the outſide of the pods, it is ſometimes carded and ſpun on the wheel; as is alſo the inner bags of the ſilk pods, theſe being firſt ſoftened in boiling water. And ſometimes the floſs is reel'd without twiſting, being drawn out by the finger into a coarſe kind of thread, ſerving for the woof of ordinary ſilks; but this and the further management of ſilk, with the various manners in which it is thrown, and prepared to be woven, do not come within the ſcope of this Treatiſe.

CHAP.

CHAP. XI.

Some additional obſervations on cleaning the hurdles from the litter made by the Silk-worms.

THOUGH ſome directions for keeping the ſilkworms clean, have, occaſionally, been interſperſed through this Treatiſe, yet it may not be amiſs to give them a particular place here; both becauſe the cleaning of the hurdles is abſolutely neceſſary to the health of the worms, and alſo becauſe, when they are grown large, it makes a principal part of the labour which is beſtowed on them; for, as the leaves are gathered and brought home by particular perſons allotted to that buſineſs, ſo almoſt the whole of their work who attend on the worms conſiſts in feeding, cleanſing, removing, and occaſionally ſeparating thoſe which do not ſicken at the ſame time.

Till the worms have paſſed their third moult, or ſickneſs, the trouble of cleaning them is very ſmall; for till they have paſs'd their firſt moult, which is ſix or eight

days from their being hatched, they need not be cleaned at all, but may lie on the fibres which they make, without being removed from them, theſe form a ſoft warm bed, and the litter which comes from the worms, being then as fine as duſt, ſoon dries, and, ſinking among the fibres, doth not at all incommode them. This, I ſay, is the caſe provided you have fed them properly, not keeping the worms too thinly ſcattered, and ſo being obliged to throw more leaves on them than they can conſume before they wither, by which means they would be buried and inveloped in the old leaves, which curl about them; this throws perſons under a neceſſity of diſengaging the worms, which, beſides the endleſs labour of it, wounds and hurts multitudes of them: and here I muſt repeat what I have formerly mentioned, that ſlicing the leaves for the young worms greatly tends to hinder their curling about them, beſides it makes the leaves go farther and produces leſs litter; a few handfuls of leaves are quickly ſliced, which ſhould be done more or leſs, in proportion to the age of the worms, till they have paſſed their

their ſecond ſickneſs, for then they can eaſily maſter the whole leaves.

As there is no neceſſity for cleaning away the fibres from under the ſilkworms till they have paſſed their firſt ſickneſs, ſo long as it remains free from moiſture or mouldneſs, ſo neither will there be any neceſſity to clean them again, till they have paſſed their ſecond moulting, ſo long as you perceive it to remain tolerably dry; but if there is a large heap of fibres, and you perceive them to have grown damp and mouldy, you may thin it as much as you think proper by taking away the under fibres, which will generally come off in flakes; if you perceive many worms buried and invelop'd among theſe fibres as you take them off, you may conclude that you have either given too much leaves when you fed them, or that they have not been all hatched at the ſame time, by which means ſome became ſick, while the reſt were in a feeding ſtate; and ſo the firſt not being in a condition to get upon the freſh leaves were buried under them and ſtarved.

You may readily take the worms off the cake of fibres when it becomes moiſt, by rolling a handful of hay between your hands

till its fibres become entangled in one another; then ſpreading it out and flattening it, it will become a ſort of net-work; lay this over your young worms, and ſtrew the freſh leaves over it, and when they are come through it, and have fixed upon the leaves, then ſlide a very thin ſhovel of board, or paſte-board, having a handle like a wool-card, under the hay, and, taking it off the cake of old fibres, ſlide it with the worms from off the ſhovel upon a clean part of the hurdle: you may very readily inſinuate the ſhovel under the hay without incommoding the worms, if, while you raiſe the hay with one hand, you by degrees thruſt the ſhovel gently under it with the other. You may let the worms be a little hungry, by faſting a little longer than ordinary, before you lay the hay over them, that they may the more quickly come up through to the freſh leaves which you give them. And therefore, that you may loſe as little time as poſſible, when you have ſpread the hay and leaves over one parcel of worms, you may proceed and do the ſame to another, and ſo on to all the different parcels which you have, by which means the firſt which you fed will be getting

ting through to their leaves while you are managing the others; for the hay and leaves ſhould remain a good while on the cake of old fibres before you remove them, that you may give the worms time to get on the freſh leaves; ſince it is troubleſome to collect the odd ſcattered worms which remain after the bulk of them is taken away, for if any remain you muſt pick them up, with the fibres to which they ſtick, and ſo lay them among the reſt.

Beſides what I have already mentioned, you will find that if you, now and then open and raiſe the cake of fibres with a hooked wire, it will contribute to keep it dry, by giving admiſſion to the air and cauſing the litter of the worms to run off. And thus to clear away their litter after each moulting may ſuffice for the keeping your ſilkworms clean until they have paſſed their third ſickneſs, during which time they lie in a narrow compaſs and are eaſily managed; for the worms neceſſary to produce twelve or fifteen pounds of ſilk may, when firſt hatched, lie on the ſpace of a foot ſquare nearly, and theſe, by the time they have arrived to their firſt moult,

may lie on a hurdle containing about ſix ſquare feet, at which time they will be about eight days old; two and an half of ſuch hurdles may contain them at their ſecond moulting; eight at their third; ſeventeen at their fourth moulting, and fifty when they are ready to ſpin: by which allowance you ſee they will take up about three hundred times the ſpace which they did when firſt hatched.

You may continue to ſhift and clean the worms by means of the ſhovels before mentioned until they have paſſed their third moult; if you keep them on the hurdle in ſuch diſtinct parcels as may be taken on a ſhovel; otherwiſe you may, ſhift them by the hand, the method of doing which may be thus; when you give them freſh leaves, and they have got upon them, take away the leaves with the worms which ſtick to them, and place them upon looſe ſtraw ſpread on a clean hurdle, and if any worms remain upon the old fibres pick up the fibres to which they adhere, and place them among the reſt. This I think is better than (as ſome adviſe) to ſcatter a few freſh leaves, and wait till the odd worms which remain have got upon

upon them, for beſides the waſte of time, the worms will often not get upon theſe freſh leaves but lie upon the hurdle while they eat them, ſo that you might wait a long time before you got them all ſhifted.

When you have a number of hurdles to clean, ſtrew freſh leaves on as many hurdles as you think proper, and by the time that you have ſtrewed them on the laſt, the worms will have got upon the leaves of the firſt. Then begin and take theſe off and place them upon a clean hurdle, and then after clearing away the litter and fibres of the hurdle from which you firſt removed the worms, it will be ready to put others on, and in this method proceed till they are all cleaned; by which means one ſupernumerary hurdle will ſerve for cleaning all the reſt, and the laſt clean'd will remain empty of worms, being the ſupernumerary hurdle with which you are to begin your next cleaning.

For the greater eaſe of ſhifting the worms, the two hurdles ſhould be taken from the ſtand, and laid near one another on a table, or ſquare frame, which may be removed from ſtand to ſtand as you have occaſion to clean them.

The

The reeds, or other materials of which the hurdles are made, are ſuppoſed to be placed ſo cloſe that, after their third moulting, little or none of their litter can fall through, leaſt it ſhould incommode the hurdles which are placed below one another on the ſame ſtand. When the reels are placed as cloſe as they can be it will not hinder, but that there will be ſufficient creviſes for the air to paſs and dry the fibres; but if the worms lie upon boards, there will be always a great deal of moiſture, for want of the free acceſs of the air, and they will often require cleaning.

Before their third moulting, the litter they make is ſmall and moſtly runs down among the withered fibres, therefore till their third moulting it may ſuffice, as I have ſaid, to clean away the litter and fibres once after each moulting, eſpecially if the weather is moderately dry, and they have eaten their meals clean, leaving nothing but the fibres, which fibres you may raiſe up here and there with a bodkin to make them lie open, and let the litter fall down. But if it is cloſe ſultry, and moiſtiſh weather you ſhould clean them often; for heat and moiſture coming together are

the

the great cauſes of putrefaction, and conſequently of diſtempers; but never offer to clean them while they are in their moulting ſickneſs, for it is then very detrimental to diſturb them; yet at other times, when you find them come lazily on the freſh leaves, and eat languidly, it will be uſeful to make their hurdles clean at that time in order to excite and rouſe them.

But the great buſineſs of cleaning is from their fourth and laſt moulting, to their time of ſpinning containing about ten days, they will then require to be cleaned every ſecond day, or oftener, otherwiſe their litter, being now in great quantity, will ſoon create moiſture and mouldineſs, and infect both the leaves and the worms.

Whatever contrivance can now be found to lighten the frequency of cleaning them would be of great uſe: it is very obſervable that at this age, their bodies being very heavy, they frequently preſs down and flatten great part of the freſh leaves, and that, after having lain on them, they ſeldom care to eat them; nor indeed can they readily get at them, while thus cover'd with worms and flattened to the hurdle: this occaſions both waſte of food and in-

creaſe of litter, therefore if any light dry materials, ſuch as the withered fibres of rape or muſtard, were ſpread on the hurdles (or framed in ſuch a manner as I ſhall hereafter mention) ſo as to form a contexture very looſe and open, about an inch or more in thickneſs, which I ſhall call bedding, this will help to keep the leaves in ſuch a ſituation as to be eaſily and wholy eaten, and will alſo prevent the worms from lieing among the litter which they make; for though, when they were young and ſmall, the fibres of the leaves formed a bedding ſufficient to ſupport them, yet at this age they ſcarce leave any fibres of the mulberry-leaves uneaten, and thoſe are too weak to ſupport their weight.

If you dreſs their hurdles in this manner their litter will roll down through the bedding and be received by the hurdle which, as formerly directed, is woven ſo cloſe as not to let it paſs, and it may be cleared away by ſhifting the bedding with the worms upon it, in large quantities at a time, upon a clean hurdle, and then ſhaking the litter off the other.

This bedding may be much improved in convenience, by fixing it in a ſlight

ſquare

ſquare frame, ſo as that it may be all at once taken off the cloſe hurdle when you intend to clean it: thus four reeds about the thickneſs of ones finger being notched and tied together, as directed in forming the rim of the cloſe hurdle, and having ſome ſmaller twigs faſtened acroſs it, ſo as to divide the ſpace into ſmall ſquares of about ſix inches, will make a ſufficient ſupport for the bedding, which may be ſpread upon it ſo as to lie about two inches thick, but ſo looſe and open that the worms might paſs through the interſtices. The outſide ſtraggling fibres may be confined within the verge of the frame by a ſtrip of thin matting going round, which will alſo form a ledge, and confine the worms.

Now this bedding may either lie upon the cloſe hurdle, ſo that both may be taken off the ſtand together when you would ſhake off the litter, or it may be ſupported on the ſtand by four nails of its own, while the cloſe hurdle is likewiſe ſupported cloſe under it by four others proper to itſelf, by which means you may take it away and ſhake off the litter without moving the worms. In order to take away the cloſe hurdle with eaſe the two fartheſt nails

that

that ſupport it, ſhould have no heads, and the two ſupports in front may be hooks moveable on a nail, which hooks being drawn back, you can lower the front ſide of the cloſe hurdle and ſo take it away; for, without thus lowering it, it would rub againſt the bottom of the bedding, and might hurt ſome of the worms which happened to lie low. Inſtead of the ſticks which ſupport the bedding in its ſquare rim, packthread may be tied acroſs to anſwer the ſame purpoſe; or nets with meſhes five or ſix inches ſquare may ſupport the bedding, and may be placed on the nails in the ſtand by two ſtiff reeds run through the meſhes of the oppoſite ſides. And here, by the way, a good method occurs of taking the young worms from off their litter and fibres when there is occaſion. Thus Plate I. Fig. VII. ſuppoſe you intended to remove all the worms which lie on a hurdle half a yard ſquare, to a thin light piece of lath A. ſomewhat more than half a yard long, fix ſeveral ſmall threads b. b. b. at about two inches diſtance, the threads ſhould be ſomewhat more than half a yard long, and ſhould have ſingle knots tied near their extremi-

ties,

ties, which are to catch and hold them ſtretched in the nicks of a thin lath E. or between wires bent and fixed in a lath, as repreſented at C. the lath ſhould be of the ſame length as the other, with as many nicks, or diviſions made by the wire d. d. d. and at the ſame diſtance as there are threads fixed on the other, into theſe nicks ſlip the knotted end of each thread, and, ſtretching them between the two laths, lay them over the worms; then make a very thin open bed of bents or hay, and lay it over the threads and worms; upon this bed ſtrow their leaves, and when the worms are come through the hay, and are fixed on the leaves, remove all together by means of the two ſticks ſtretching the threads which lie under and ſupport the bed; and when you have placed them on a clean hurdle ſlip the knotted ends of the threads out of the nicks, and, taking hold of the other ſtick, draw away the threads ſoftly from under the bed, and uſe them in the ſame manner for removing other worms, or for diſpatch you may have a good many of theſe threaded laths.

Theſe things are ſomewhat tedious and troubleſome in deſcription, but of very

eaſy

eaſy performance; and, according as they are found uſeful, may be varied and improved in diſcreet hands. Some might think that ſmall nets would do as well as theſe threads which I have deſcribed above; but if it is conſidered that the meſhes of theſe would never allow them to be drawn away with eaſe, and that beſides they would be liable, in drawing away, to lay hold of ſome of the worms and cut them, then it will eaſily be ſeen how much this method is preferable.

With regard to the bedding which I was mentioning you muſt take notice, that tho' ſtiff fibres, or perhaps ſtraw, may ſerve for grown worms, yet when they are young light bents or hay is fitteſt, always proportioning the ſtiffneſs of the beds to the age of the worms, and making it ſo looſe and open that they may eaſily paſs through it. In the large hurdles, that are thus bedded with ſtraw, you may ſtretch two or three ſtrings over the ſtraw to keep it in its place, if you ſhould have occaſion to turn the frame upſide down to ſhake off any leaves or litter that lie on it. If you uſe ſtraw for the bedding, and the weight of the worms ſhould preſs the

ſtraw

ſtraw too cloſe, you may now and then fork it up to make it lie looſe and open.

When you uſe the forementioned beddings of hay or fibres, *&c.* you need not clean the cloſe hurdles under them till you find the litter is ſo thick as to hinder the air's paſſing freely through their creviſes, ſo that by this method you will be eaſed of a good deal of labour, and the worms will lie clean, and clear of their litter, neither will they ſo much croud one another, the thickneſs of the bed affording them more ſpace to lie in. It will be uſeful to have a broad ſhallow baſket, made ſo cloſe at bottom as not to let the litter paſs through, upon which you may lay the cloſe hurdles to beat off the litter, and ſo convey it out of the room; for if it were ſpilled on the floor, and trodden under foot, it would become very noiſome; when you replace the cloſe hurdle, after cleaning, turn the under ſide of it next the worms, becauſe it will be the moſt dry and ſweet. The more open and buſhy ſuch materials are of which you make theſe beds, the more they will reſemble the branches of trees, among which the worm feeds in its natural ſtate; it muſt however,

be remembered that at the laſt time of cleaning the hurdles, when the worms are ready to ſpin, the beds ſhould be taken away, otherwiſe they will make their pods among the ſtraw or fibres, where their litter would foul them, and there would be a loſs of ſilk in drawing away the pods; therefore, at that time the worms muſt be laid on the hurdles, without any bedding under them.

Thus far it ſeemed to me neceſſary to enlarge on the ſubject of keeping ſilkworms clean in a detach'd chapter, that I might not too much interrupt the method and order of the book; and I thought it a ſubject too material to be omitted, even tho' only one uſeful rule of practiſe were ſuggeſted by the whole chapter.

Among ſuch a multiplicity of precepts and obſervations, ſome things may poſſibly have eſcaped my attention; one at preſent occurs which is, that an equal continued degree of warmth is what ſilkworms beſt thrive in, and this degree is about the eighteenth of *Reaumur*'s Thermometer, and ſixty ſeventh of *Fahrenhait*'s, for ſilkworms will without any detriment bear ſome variation above and below this degree. I ſhall only juſt mention one thing more,

more, and then with a few queries propoſed upon it, put an end to this treatiſe.

The *Chineſe* are ſaid to give themſelves no more trouble, in many places, than barely to hatch the worms after which they place them on the mulberry-trees, where they feed and make their pods without the trouble which attends keeping them in houſes. It ſhould be inquired whether this is fact, and then

How do they preſerve the worms from birds, ſnakes, lizards, *&c?*

Doth the weather never injure them?

How are the injuries of the weather prevented?

Will any climate in our colonies allow of ſuch management?

May not low ſhelter'd hedges of mulberry-trees anſwer beſt for a trial of this?

May not ſome cheap covering be found or matting formed like a pent-houſe to defend ſuch hedges from perpendicular rains of?

May not the attendance of a boy be ſufficient to keep off birds, lizards, *&c.* can dogs, or hawks be trained, or ſtation'd for this purpoſe?

Will not hedges be pretty well ſheltered from winds by large trees planted proper-

ly, and from rains which drive with the wind, by making them run in length parrallel to the direction of the moſt rainy winds ?

Is it not worth while to make ſome trials of this ſort, in our colonies, where hands are ſo much wanted ?

IN-

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Note, Alſo that the pullies plac'd at the top of the pole, Plate II. Fig. III. may be fixed to a ſeparate piece of wood, ſo as to ſlide, and be drawn up or down by a rod with a hook, for the eaſe of getting at them.

FINIS.

ERRATA.

Page 49. lin 13. *read*, on trees. Pag. 80 lin. *ult.* for a perſon *read* perſons. Pag. 123. lin. 10. for ſhews *read* ſhew. Pag. 198. lin. 11. for ſcraped *read* ſcrape. Pag. 269. lin. 10. *read*, not only owing. Pag. 102. lin. penult for E. G. I. *read* F. G. I. Pag. 249. lin. 3. for M. N. *read* W. X. Pag. 268. lin. 15. *dele* or turn'd awry.

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